RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 54 FEBRUARY, 1950 No. 2

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A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Acute Primary Pulmonary Blastomycosis[1]

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BLASTOMYCOSIS was first described by Gilchrist in 1894 as a form of chronic dermatitis. Since that time, many articles have appeared in the literature dealing with the chronic cutaneous lesions (11). Numerous reports have been published describing secondary pulmonary invasion (4, 11), and a few on primary chronic pulmonary blastomycosis (11, 12).

Review of the literature reveals only one case which can be interpreted as an acute primary pulmonary blastomycosis. Healy and Morrison, in 1931 (9), described an acute pneumonic process in a patient with persistent blastomycetes in the sputum. A roentgenogram showed a left basal infiltration with associated hilar lymphadenopathy. In the absence of follow-up, however, we do not know whether the disease process subsided or became chronic.

Primary pulmonary lesions due to other fungi have been described since 1935. Dickson, in 1937 (5), discussed the primary lesions of coccidioidomycosis, which subsided spontaneously. Carter (2, 3) and Jamison and Carter (10) added to the earlier description. The clinical picture is similar to that of other primary infections, with headache, chest pain, temperature of 100–102°, slight elevation of the white blood count, and a moderately productive cough predominating. Roentgenograms early reveal a pulmonary infiltration varying from thickening of the hilar shadows to almost complete consolidation. About 33 per cent of the cases in which the disease persists for any period of time show some degree of mediastinal or hilar lymphadenopathy; parenchymal infiltrations tend to become nodose, and in some instances cavitation develops. Pleural effusion appears in approximately 20 per cent of all cases. Death is rarely due to the primary invasion except when dissemination occurs.

Zwerling and Palmer, in 1946 (13), postulated an acute benign form of histoplasmosis on the basis of pulmonary calcifications associated with a negative response to tuberculin and a positive response to histoplasmin skin tests. Furcolow, Mantz, and Lewis, in 1947 (6), reported 72 asymptomatic cases of pulmonary infiltration with positive histoplasmin skin tests. They divided the infiltrates into three groups. Nodular foci were present in 49 of the 72 cases. These foci varied from 0.5 cm. to 3.5 cm. in diameter and occasionally had calcific centers. In 39 cases of this group there was associated mediastinal or hilar lymphadenopathy. Pneumonic infiltration was present in 17 cases, and in 14 of these there was associated hilar

[1] Presented before the Radiological Society of North America at the Thirty-fourth Annual Meeting, San Francisco, Calif., Dec. 5 to 10, 1948. Appreciation is expressed to the Department of the Army, Office of the Surgeon General, for permission to use this material.

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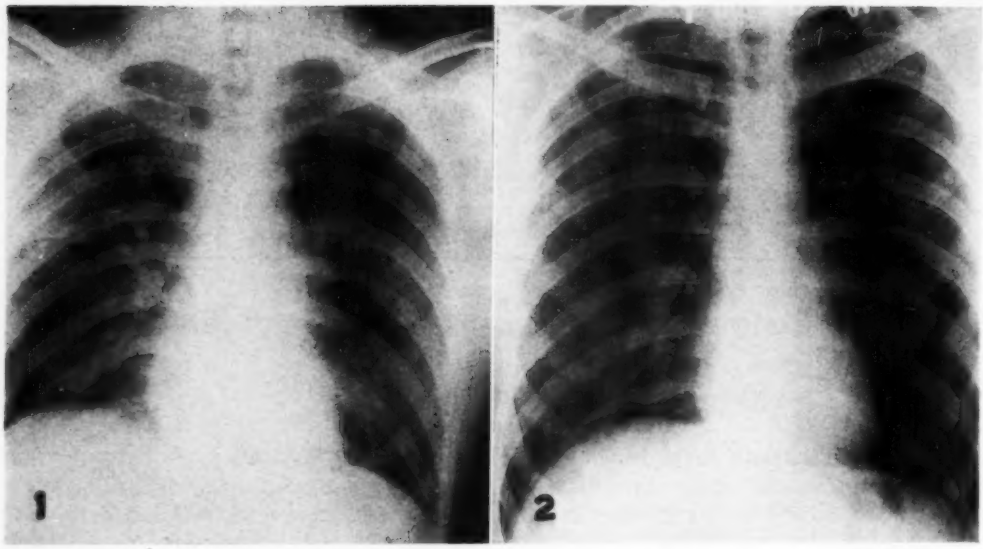


Fig. 1. Case I: Patchy infiltration in right upper and left lower lobes with moderate hilar lymphadenopathy.
Fig. 2. Case I: Small residual infiltration in right second interspace and marked resolution of lymphadenopathy after nineteen days.

lymphadenopathy. This lesion is described as a single, persistent patch of pneumonitis about 2 cm. in diameter. Disseminated infiltrates occurred in 3 cases, in 2 of which there was associated lymphadenopathy. The lesions in this group varied from the size of a millet seed to large patchy areas. No deaths are reported in the series and follow-up on many of the cases revealed calcification replacing the active process.

Acute pulmonary torulosis has not been reported, although the chronic form has been described by Greening and Menville (7). Hamilton and Tyler (8) have described the asymptomatic pulmonary lesions, not as a benign disease, but as the possible precursor to central nervous system involvement. The infiltration may appear roentgenographically as a hazy opacity which slowly regresses and finally becomes nodose. Lymphadenopathy does not seem to be a prominent feature. As involvement of the central nervous system becomes evident, the pulmonary lesions may have completely regressed under iodine therapy.

Cain, Devins, and Downing, in 1947 (1), reported 26 cases of an acute pulmonary infection apparently due to *Monilia*. All patients were exposed for a relatively short period of time to a common locale, following which the respiratory infection became evident in from eight to eighteen days. The clinical picture was similar in most cases, temperature in the region of 104°, chest pain, headache, and a productive cough predominating. The white blood count was not remarkable. The sputum from 16 of the cases revealed *Monilia albicans*. The roentgenograms of the chest were characterized by many small areas of infiltration, 2 mm. to 20 mm. in diameter, scattered diffusely throughout both lung fields. Varying degrees of hilar lymphadenopathy were demonstrable in all cases. Resolution of the lesions was slow, and at six months the roentgenogram revealed a diffuse, fine fibrosis. The decrease in size of the hilar lymph nodes paralleled the decline of the parenchymal lesions.

In addition to the above mentioned diseases, the following must be considered when the diagnosis is in doubt and the roentgenogram shows lesions similar to those described above: tuberculosis, sarcoidosis and the lymphomatoid group (3).

The cases of acute primary pulmonary blastomycosis to be described here occurred in U. S. Army personnel on Okinawa, an island 65 miles long and 10 miles wide, situated about 800 miles northeast of the Philippines. No information is available as to the incidence, if any, of the disease in the Okinawan natives. All cases, with the exception of one (Case VI), developed during the months of November and December 1946. The climate at that time was unusually humid. The usual winter rains were diminished, and the air was constantly filled with dust, which is a factor in the dissemination of the fungus (2). The high humidity gave rise to large amounts of mold within the living quarters of the American troops.

Twenty-three cases occurred during the period mentioned, in only 6 of which were positive roentgenograms obtained. In the 17 subclinical infections, the organism was identified incidentally on routine sputum and urine examinations, and roentgenograms were not obtained in these cases. In every instance, the organism was identified in either the sputum or the urine, and sometimes in both.

The following 6 cases are the only ones with positive clinical and radiological findings.

CASE I: G. E., a 19-year-old Negro male, entered the hospital on Oct. 31, 1946, complaining of a productive cough, slight chills, dull pain in the left side of the chest, and anorexia for two weeks prior to entry. He had left the United States on July 17, 1946, arriving at Okinawa without stopovers.

The temperature was 101°, pulse 90, and blood pressure 120/80. Examination revealed crackling râles and increased breath sounds in the left lung field. The skin was free of any type of lesion, and there was no evidence of peripheral lymphadenopathy. The sputum was grayish-yellow and copious.

Examination of the blood revealed a negative Kahn reaction and a corrected sedimentation rate of 41 mm. The white blood cell count on Nov. 6 was 11,800, with 72 per cent polymorphonuclears, 26 per cent lymphocytes, and no eosinophils. Examination of the urine, sputum examination for acid-fast bacilli, and the Frei test for lymphogranuloma venereum were negative.

Roentgen examination of the chest on Nov. 29 revealed a soft, patchy infiltration predominant in the right upper and the left lower lung fields, with a moderately severe bilateral hilar lymphadenopathy (Fig. 1).

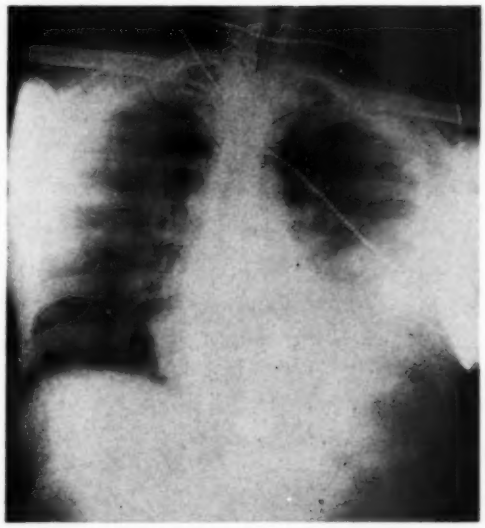


Fig. 3. Case II: Left pleural effusion with right hilar lymphadenopathy.

The course was one of slow recovery without specific therapy. The corrected sedimentation rate showed a progressive decrease from the admission high of 41 mm. to 7 mm. on Dec. 8. The white blood cell count dropped to 6,100 on Nov. 20, with 68 per cent polymorphonuclears, 26 per cent lymphocytes, and 3 per cent eosinophils. A repeat examination on Nov. 26 showed no change. Thirty-four smears and concentrations of the sputum were negative for acid-fast bacilli; the organism was isolated on Dec. 2. All urine examinations were negative until Dec. 8, when the organism was found.

Roentgen examination of the chest, on Dec. 18, revealed a small amount of residual infiltration in the right upper lobe, with almost complete resolution of the hilar lymphadenopathy (Fig. 2).

The patient was evacuated to the States in the latter part of December 1946, asymptomatic.

CASE II: R. A., a 20-year-old white male, was admitted to the hospital on Dec. 7, 1946, acutely ill. He died after twelve hours in the hospital.

The temperature was 103.6°, pulse 110, and blood pressure 90/50. Examination of the chest revealed dullness at the left base, which was thought to represent consolidation. There was no evidence of any cutaneous lesion or palpable lymphadenopathy. The physical examination was otherwise negative.

Laboratory studies were not done. Roentgen examination of the chest showed a moderate pleural effusion obscuring the lower half of the left lung field, with a suggestion of minimal hilar lymphadenopathy (Fig. 3).

Autopsy, performed on Dec. 8, revealed the organism in the left lung parenchyma and in the pleural fluid. The tracheobronchial lymph nodes were enlarged.

CASE III: F. N., a 21-year old Filipino male, entered the hospital on Dec. 10, 1946, complaining of cough for one week, headache for four days, and a temperature of 100° for three days. The patient had arrived on Okinawa on Dec. 1, 1946, having spent the previous six months in Manila. There was no history of any cutaneous lesions.

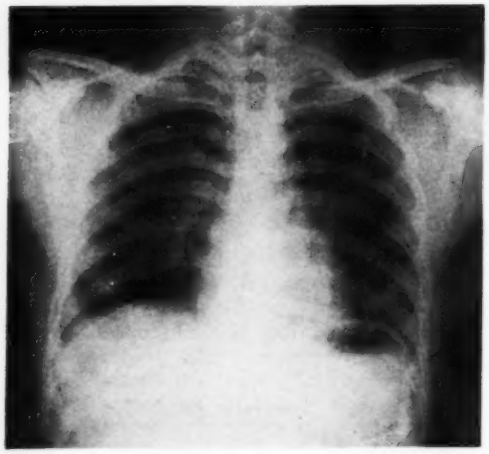


Fig. 4. Case III: Small patchy infiltration at both bases with bilateral minimal hilar lymphadenopathy.

Physical examination showed a temperature of 101°, pulse 90, and a blood pressure of 120/80. There was no evidence of cutaneous lesions or peripheral lymphadenopathy. Medium moist râles were present throughout both lung fields. The sputum was slate-gray and moderate in amount.

The blood Kahn test was negative, and the corrected sedimentation rate was 26 mm. The white cell count was 11,600, with 70 per cent polymorphonuclears, 28 per cent lymphocytes, and 2 per cent eosinophils. A Frei test for lymphogranuloma venereum was negative. Examination of the urine was negative until the organism was isolated on Dec. 13. The organism was isolated from the sputum on the same day.

Roentgen examination of the chest, on Dec. 13, revealed a small patchy infiltration at both bases, with moderate bilateral hilar lymphadenopathy (Fig. 4). Recovery was spontaneous, without specific therapy, and the patient was returned to duty by the end of December 1946.

CASE IV: B. D., a 31-year old white male, was admitted to the hospital on Nov. 26, 1946. The presenting complaints were headache, low back pain, mild chest pain, and a non-productive cough, all present for three days prior to entry. The patient had been on Okinawa for one and one-half years and in that time had had attacks of malaria. He gave no history of any cutaneous lesions. Physical examination on entry was essentially negative.

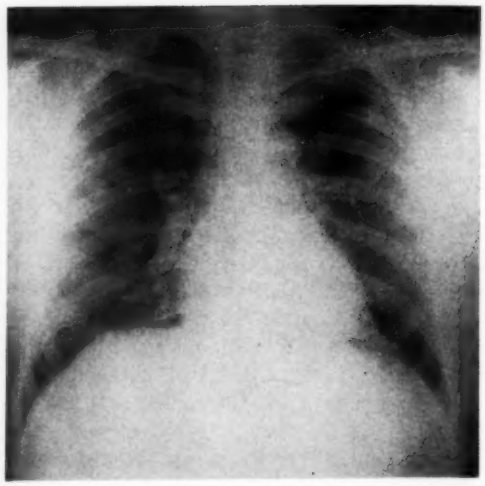


Fig. 5. Case IV: Round-focus lesions in left second and right third interspaces and hilar lymphadenopathy.

The blood Kahn test was negative, and the corrected sedimentation rate was 1 mm. The white cell count was 7,800, with a normal differential count.

Roentgen examination of the chest revealed a round focus lesion, 1.5 cm. in diameter, overlying the lateral portion of the left second rib. A similar lesion was present in the right third interspace, with associated hilar lymphadenopathy (Fig. 5).

The patient's condition remained essentially unchanged until Dec. 2, when the cough become productive of a grayish sputum. Ten smears and concentrations of the sputum were negative for acid-fast bacilli, with identification of the organism on Dec. 10. The corrected sedimentation rate was 24 mm. on Dec. 3 and 31 mm. on Dec. 10. The white cell count on Dec. 3 was 11,600 with a normal differential count, dropping to 7,500 on Dec. 10. All urine examinations were negative until the organism was isolated on Dec. 10.

The sputum was still positive and the chest film was unchanged at the time the patient was evacuated to the States.

CASE V: M. E., a 26-year old white male, was admitted to the hospital on Nov. 6, 1946. The presenting complaints were cough, chest pain, and temperature elevation for four days. The patient had been on Okinawa for four months, arriving there direct from the States. He gave no history of previous cutaneous lesions. Physical examination revealed many moist râles throughout both lung fields. The remainder of the examination was negative.

Examination of the blood showed a negative Kahn

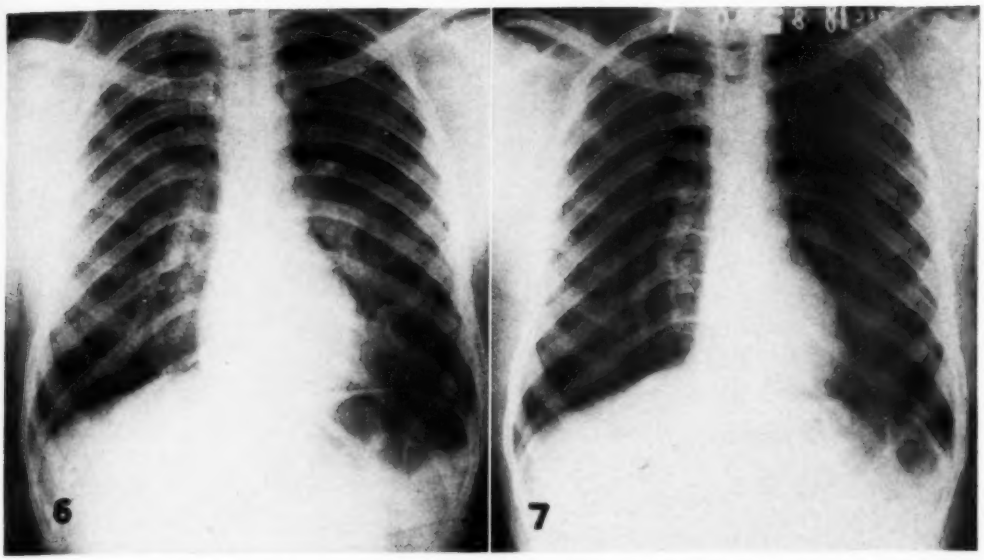


Fig. 6. Case V: Fine mottled infiltration throughout both lung fields associated with hilar lymphadenopathy.
Fig. 7. Case V: Marked resolution of the infiltration and moderate resolution of the lymphadenopathy after twenty-eight days.

test, a corrected sedimentation rate of 21 mm., and a white cell count of 9,500 with a normal differential count. Examination of the sputum and urine was negative. Roentgen examination of the chest showed a fine, mottled infiltration throughout both lung fields, with left hilar lymphadenopathy (Fig. 6).

The patient became progressively worse until the twentieth day, in spite of sulfonamides, penicillin, several blood transfusions, and supportive therapy. Following this, he improved slowly but began to produce moderate amounts of grayish sputum.

Additional laboratory work revealed a corrected sedimentation rate of 40 mm. and 12,200 white blood cells with a normal differential count. The organism was isolated from the sputum and the urine on Dec. 9. Another chest roentgenogram, on Dec. 18, showed almost complete resolution of the infiltration except for a small area in the right second interspace. The left hilar lymphadenopathy had moderately resolved (Fig. 7). The patient was evacuated to the States at the end of December, asymptomatic.

CASE VI: A. P., a 31-year old white female, entered the hospital on March 25, 1947, complaining of right chest pain, fever, and a productive cough for the previous two days. She had been on Okinawa for the past eight months. There was no history of any cutaneous lesions.

The patient appeared moderately ill, without cutaneous lesions or lymphadenopathy. Auscultation revealed moist râles in the right upper chest posteriorly. The remainder of the examination was essentially negative. The sputum was slate-gray in color.

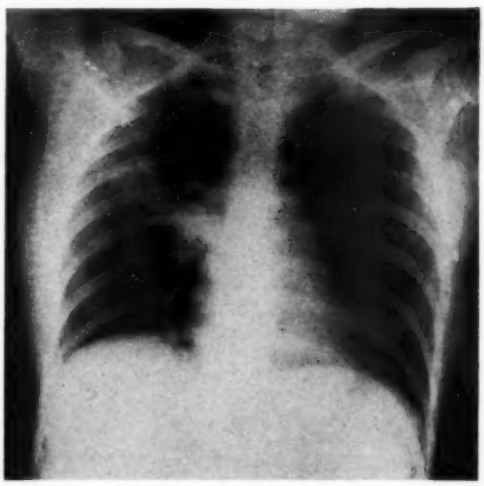
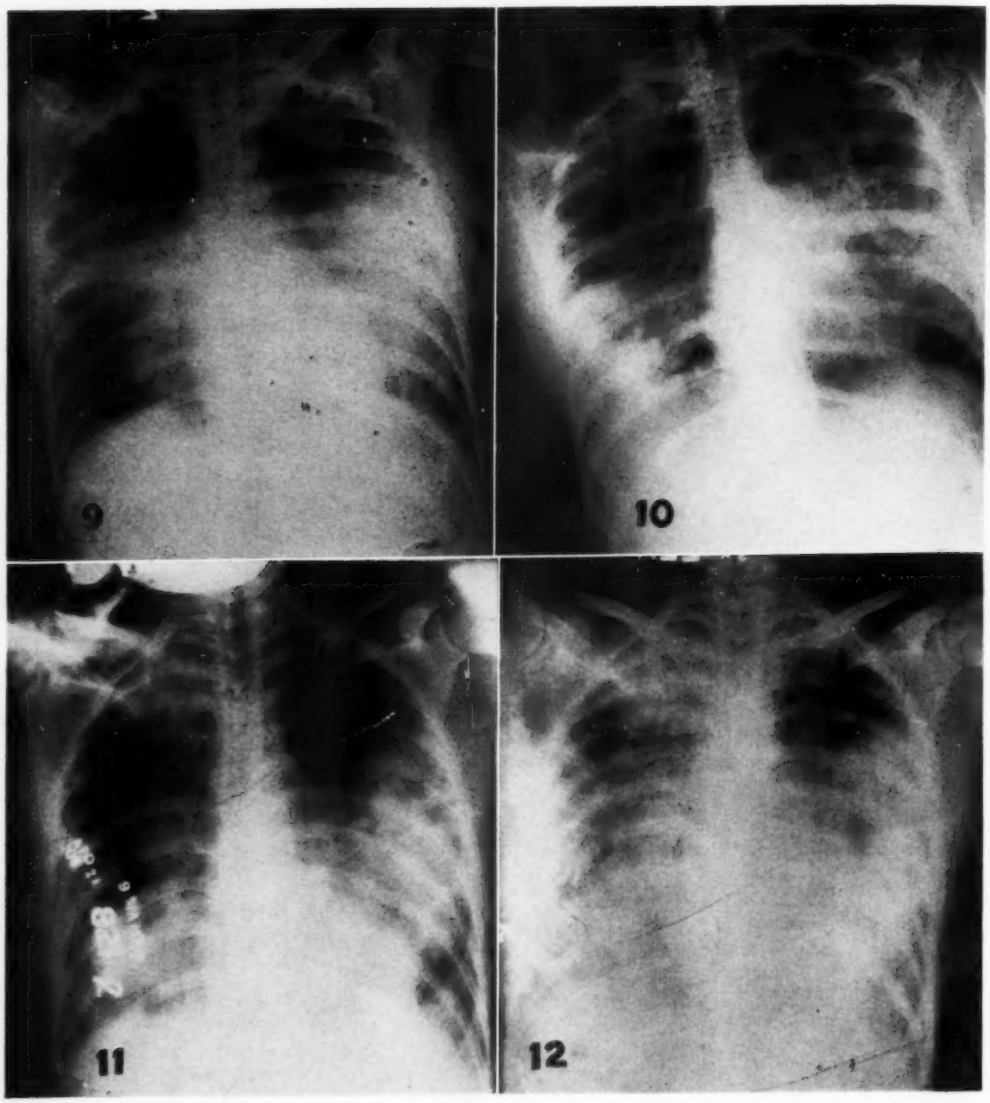


Fig. 8. Case VI: Semiconfluent infiltration in the right mid-lung field with fullness in the right hilus on March 26, 1947.

Examination of the blood showed a negative Kahn test, a corrected sedimentation rate of 31 mm., and a blood cell count of 13,300 with a normal differential count. Sputum and urine examinations were negative.

Roentgen examination, on March 26, revealed a semiconfluent infiltration in the right mid-lung field laterally, with accentuation of the right hilar shadows (Fig. 8).



Figs. 9–12: Case VI: 9. Progression on March 29. 10. Further progression on April 1. 11. Further progression on April 2. 12. Final examination on April 3, eight days after first roentgenogram.

The patient became rapidly worse despite sulfonamides, penicillin, streptomycin, oxygen and helium, and several blood transfusions. The organism was isolated from the sputum on the third hospital day.

Roentgenograms on March 29 demonstrated a diffuse infiltration in the middle third of the right lung field, the right middle lobe, and the lower two-thirds of the left lung field (Fig. 9). Examination on April 1 showed clearing of the right upper lung field but involvement of the right lower lobe, with some resolution on the left (Fig. 10). The findings were essentially unchanged on April 2, but there was involvement of the right middle lobe (Fig. 11).

On April 3 almost all the lung fields showed involvement, with the exception of the upper third of the left lung (Fig. 12). In all the roentgenograms a fullness of the hilar areas was demonstrable, being interpreted as hilar lymphadenopathy.

The patient died on the tenth hospital day despite all therapy. Autopsy, performed on April 4, 1947, revealed a disseminated type of invasion. The organism was identified in the brain, liver, lung, and

spleen. Organisms were also isolated from the sputum, urine, and feces.

COMMENT

The acute form of pulmonary blastomycosis appears to be characterized by: (*a*) a prodrome of three to fourteen days; (*b*) localized chest pain; (*c*) productive cough with grayish sputum; (*d*) oral temperature in the region of 101 to 102°; (*e*) absence of superficial lymphadenopathy; (*f*) absence of any type of cutaneous lesion; (*g*) a white cell count in the range of 11,000 to 12,000, with a normal differential count; (*h*) moderate elevation of the corrected sedimentation rate; (*i*) isolation of the organism from the sputum, urine, and possibly the feces; (*j*) non-specific infiltration in the lungs as demonstrated by x-ray.

In this small group of cases, 3 showed small, hazy, patchy areas; 1 presented round-focus lesions; 1 showed progressive consolidations; and 1 was manifest only by pleural effusion. In all cases lymphadenopathy of a moderate degree was present, either hilar or mediastinal. The roentgenogram is characteristic only of a general group of diseases, such as coccidioidomycosis, histoplasmosis, and other primary fungous diseases.

The acute form appears to be benign as a rule, but may become disseminated and lead to death in a short period of time.

SUMMARY

1. Six cases of acute primary pulmonary blastomycosis are presented with their varied roentgen findings.

2. The infection may occur without roentgenographically demonstrable lung findings.

3. No specific roentgen findings are evident to aid in the diagnosis of the acute form of the disease.

4. The only conclusion that can be drawn from the roentgenogram of the chest is that the disease is one of granulomatous origin and should be considered along with primary tuberculosis, coccidioidomycosis, moniliasis, histoplasmosis, and torulosis. The final diagnosis rests upon laboratory examination of sputa and urine.

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SUMARIO

Blastomicosis Pulmonar Primaria Aguda

En 6 casos de blastomicosis primaria aguda del pulmón hiciéronse estudios roentgenológicos. Los casos, junto con otros 17 subclínicos, sin estudios radiográficos, ocurrieron en el personal del Ejército de los E. U. A. en la isla de Okinawa. Dos culminaron en la muerte.

Caterízase la enfermedad por un pe-

ríodo prodrómico de tres a catorce días, dolor torácico localizado, tos húmeda con esputo ceniciento, fiebre de 38° a 39.5°, ausencia de linfadenopatía superficial y de lesiones cutáneas, fórmula leucocitaria de 11,000 a 12,000 e índice de eritrosedimentación moderadamente elevado. El miceto etiológico puede aislarse del esputo y la orina, y posiblemente de las heces.

Los hallazgos roentgenológicos en los casos estudiados variaron. Tres enfermos revelaron pequeñas zonas de placas nebulosas, uno focos redondos, uno hepatización evolutiva y uno solamente derrame pleural. En todos había moderada linfadenopatía hiliar o mediastínica.

El cuadro roentgenológico no es típico, y la única conclusión que cabe sacar de las radiografías torácicas es que la dolencia es granulomatosa en su origen y debe recibir consideración en el diagnóstico, junto con la tuberculosis primaria, la coccidioidomicosis, la moniliasis, la histoplasmosis y la torulosis. El diagnóstico definitivo se basa en el examen del esputo y la orina en el laboratorio.

DISCUSSION

Ray A. Carter, M.D. (Los Angeles, Calif.): Dr. Bonoff has made a most useful contribution in presenting primary, spontaneously recovering pulmonary blastomycosis. The mortality in his symptomatic cases is high as compared with other primary pulmonary fungous infections, but the 17 cases in which organisms were recovered from the sputum in absence of clinical manifestations give reason to assume that cases occur having minor pulmonary symptoms whose origin may not be recognized, as in other fungous diseases. How widely this may occur will be for the future to determine.

Routine roentgenograms of the chest whenever pathogenic fungi are found in the sputum are logically indicated, and search of the sputum for fungi as well as acid-fast bacilli in patients having positive findings on survey films of the chest would probably reveal other cases. In either event, the available immunologic tests may be useful.

The features of chest pain and pleural effusion mentioned by Dr. Bonoff in primary blastomycosis are shared by other primary fungous diseases, particularly coccidioidomycosis. It is of interest that no arthralgias are cited by Dr. Bonoff, as they are frequently encountered in coccidioidomycosis and have on occasion led to an erroneous conclusion of a rheumatic state.

The early appearance of hazy, nodose lesions in Dr. Bonoff's cases is of interest. These nodose appearances occur in other primary fungous diseases, including torulosis and coccidioidomycosis. In such diseases the nodose lesions may remain as a residual manifestation following the resorption of more extensive confluent lesions. The rate of resorption is very variable; it may require several months. In torulosis these lesions are cited as a predominant and presumably an initial feature.

The tendency to associated intrathoracic lymphadenopathy is shared by a number of primary fungous infections. Many of these lymphadenopathies are not advanced, are relatively obscure on the film, and are easily missed if not specifically sought.

It is probable that primary fungous infections spontaneously recovering are frequently diagnosed as primary atypical pneumonia because of the roentgenographic manifestations and clinical symptoms occurring in absence of a frank leukocytosis. If cases of supposed primary atypical pneumonia receive the appropriate immunologic tests available, some fungous infections may be recognized.

Dr. Bonoff properly disclaims an attempt to cite any of the roentgenologic features as specific for blastomycosis. They are of a type, however, that may be considered suspicious of a fungous infection.

Hodgkin's Disease of the Lung: Roentgen Appearance and Therapeutic Management[1]

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ALTHOUGH THE involvement of the pulmonary parenchyma in Hodgkin's disease is well known, the subject remains of considerable interest to radiologists. In this communication, a series of 35 cases of Hodgkin's disease of the lung, selected from a survey of 140 histologically proved cases followed in the Radiotherapy Department of the Veterans Administration Hospital (Bronx, N. Y.), is presented to demonstrate the striking variability of the roentgen appearance. The series includes essentially every known pulmonary manifestation of the disease and affords evidence of the challenging complexity of this type of complication, especially from the standpoint of differential diagnosis. Onset with predominantly pulmonary manifestations may lead to erroneous diagnoses such as tuberculosis, pulmonary abscess, sarcoidosis, mycotic infection, or bronchogenic carcinoma, with consequent mismanagement. The prompt diagnosis of the disease is therefore a matter of considerable practical importance. In addition, it is felt that some therapeutic considerations merit emphasis.

HISTORICAL REVIEW

The history of pulmonary Hodgkin's disease has been traced in detail by Wessler and Greene (24), Falconer and Leonard (7), Vieta and Craver (23), and Hoster and Dratman (11) in this country, and by Versé (22), Uehlinger (21), and Perrier (16) abroad.

The incidence of involvement of the lung parenchyma has been variously reported, as follows:

Castex *et al.*	16 cases in a series of 340
Goldman *et al.*	Less than 8% in a series of 319 cases
Jackson and Parker	14% in 170 cases of Hodgkin's granuloma, 28% in 32 cases of Hodgkin's sarcoma
Moolten	9 cases in 18 autopsies
Perrier	70 cases in a series of 273
Vieta and Craver	34% in a series of 297 cases
Wolpaw *et al.*	40% in a series of 55 cases

There is essentially universal agreement as regards the various modes of spread of the disease to the lung. Uehlinger, Versé, Vieta and Craver, and Hoster and Dratman are agreed that the three chief modes of extension of the disease are (*a*) lymphogenous and (*b*) hematogenous dissemination from more distant foci and (*c*) propagation by direct contiguity from a pre-existing focus of involvement in the mediastinal nodal structures. Still another mode of dissemination is that originally described by Wessler and Greene, namely, autochthonous foci developing spontaneously in the lymphoid tissue of the lung.

Hoster *et al.* indicate that the roentgen appearance of the pulmonary lesions may vary according to their origin. Thus, the *hematogenous* dissemination of the disease would result in diffusely scattered nodules and the *lymphatic* spread in linear or feathery densities corresponding to the distribution of the peribronchial lymphatics. Those lesions which develop as a result of direct extension would radiate from the hilar area to involve a variable segment of pulmonary parenchyma.

Perrier postulates that ultimately Hodgkin's disease is featured by successive

[1] From the Department of Radiology, Veterans Administration Hospital, Bronx, N. Y. Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors. Read by title at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.

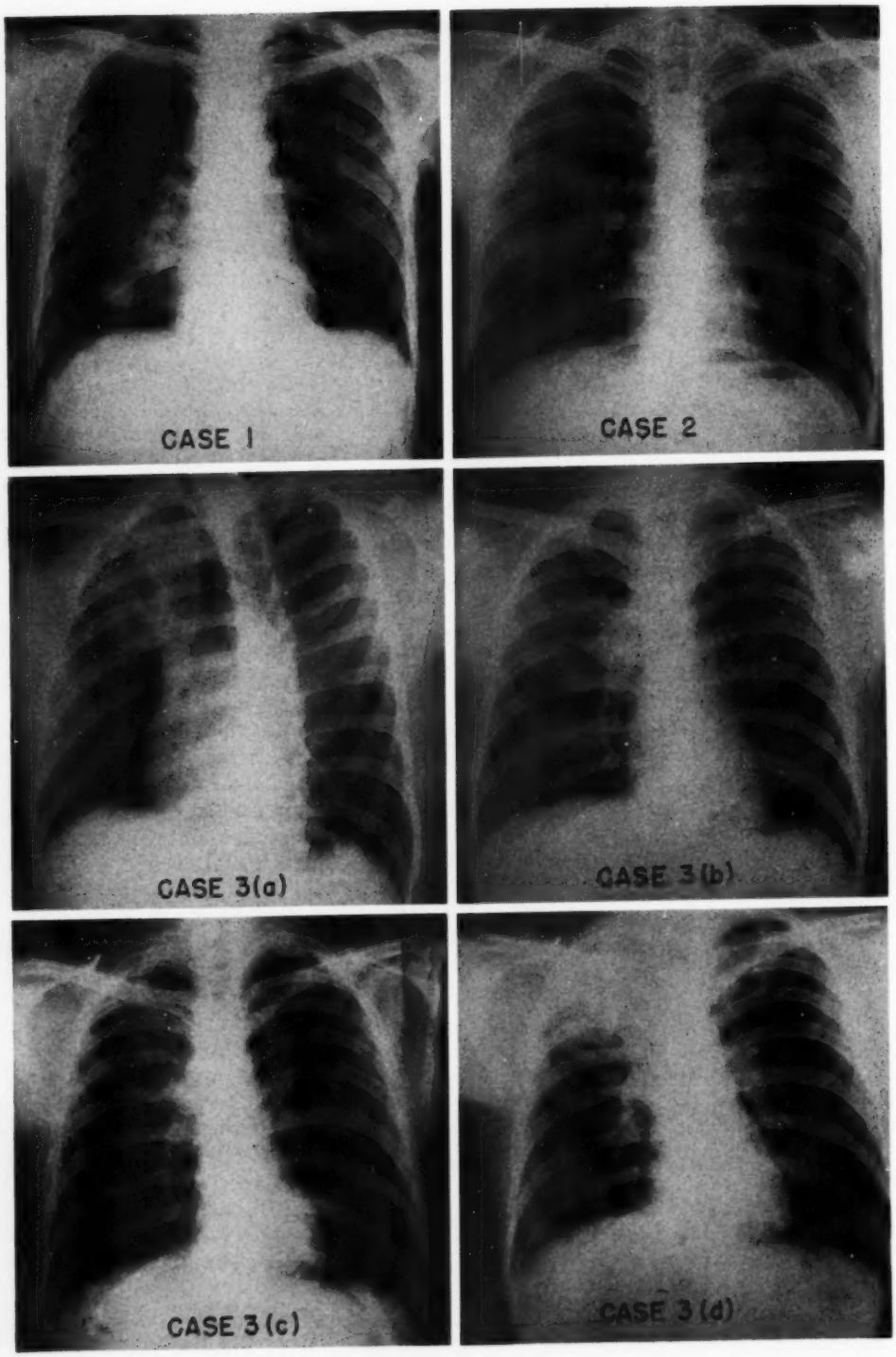


Figure 1 (Legend at foot of opposite page)

episodes of generalization and that the pulmonary lesions closely mirror the occurrence and degree of dissemination. A corollary opinion is expressed by Vieta and Craver, who state that the entire lymphatic system seems to react as a whole to the exciting agent responsible for the disease. Herbut, Miller, and Erf (10) define this agent as a specific metabolic substance capable of stimulating the reticulum cells of the lymphatic system to proliferation.

The possiblity of pulmonary involvement as the solitary manifestation of the disease has received consideration. Versé estimated that approximately 10 per cent of Hodgkin's disease was primary in the lung, and cases are reported by Castex, Pavlovsky, and Valotta (3), Ponthus and Bouvier (17), Alix y Alix (2), and Charr and Wascolomis (4). Jackson and Parker (12) and Vieta and Craver, however, were unable to classify a single case as an example of primary pulmonary disease.

ROENTGEN APPEARANCE

Numerous classifications of the roentgen appearance of parenchymal lesions observed in Hodgkin's disease have been proposed. The one offered by Versé appears the most compact, yet adequately comprehensive and descriptive. The 35 cases of Hodgkin's disease of the pulmonary parenchyma discussed in this paper will be catalogued according to this classification, with slight modifications:

I. Direct invasion of the lung in the presence of mediastinal nodal disease
II. Peribronchial or endobronchial infiltrates in the presence of mediastinal nodal disease
III. Massive homogeneous infiltrates—so-called "lobar infiltrates"—with varying degrees of mediastinal nodal disease
IV. Lobular infiltrates with varying degrees of mediastinal nodal disease
  (1) Punctate and/or mottled densities involving a variable segment or segments of lung, usually basilar—unilateral or bilateral
  (2) Circumscribed nodular densities
    (*a*) Solitary, isolated
    (*b*) Solitary, in the presence of extensive disease elsewhere in the pulmonary parenchyma
    (*c*) Multiple, diffuse bilateral (ultimately coalescent)
  (3) Confluent irregular densities
    (*a*) Solitary
    (*b*) Multiple
    (*c*) Widely disseminated (ultimately coalescent)
V. Generalized dissemination
  (1) True miliary
  (2) Lymphangitic spread

The subject of mediastinal lymphadenopathy will not be considered in this discussion, other than to define the "mediastinal nodes" as those nodal structures which are found at the paratracheal, carinal, and hilar regions, as well as at the angle of the larger bronchial divisions. This matter has been adequately reviewed in numerous articles. It may be stated, however, that 90 per cent of our patients presented demonstrable mediastinal nodal disease at some interval during their illness.

I. Direct Invasion of the Pulmonary Parenchyma in the Presence of Mediastinal Nodal Disease: It is surprising that this mode of dissemination is not more frequently observed in view of the uniformly high incidence of mediastinal node involvement.

The invasion of the pulmonary parenchyma may be radiographically revealed in the form of a discrete, well circumscribed lesion, or lesions, whose relationship to a parent hilar mass is demonstrated. The

Fig. 1. Case 1: Direct invasion of lung by circumscribed lesion. Circumscribed nodular lesions in the medial aspect of the right lower lung field and in the lower pole of the right hilus, as well as a right paratracheal mass. These findings were confirmed at autopsy one month later.

Case 2: Direct invasion of pulmonary parenchyma. Routine follow-up roentgenogram on a patient with known Hodgkin's disease of three years duration, showing a left parahilar mass irregularly infiltrating the parenchyma of the left upper lobe. The similarity to bronchogenic carcinoma is notable.

Case 3: Direct invasion of lung, with cavitation. (*a*) Left anterior oblique roentgenogram of chest taken August 1946, demonstrating an area of cavitation in a right parahilar mass. (*b*) Follow-up study six weeks later, showing a dense right parahilar mass with linear extensions into parenchyma of right upper lobe. Operation disclosed an inoperable mass arising from the right side of mediastinum, and infiltrating the right upper lobe. (*c*) Examination of chest following irradiation of right parahilar mass (3,000 r tumor dose in 30 days), showing pronounced regression of previous lesion. (*d*) Marked extension of lesion in right upper lobe.

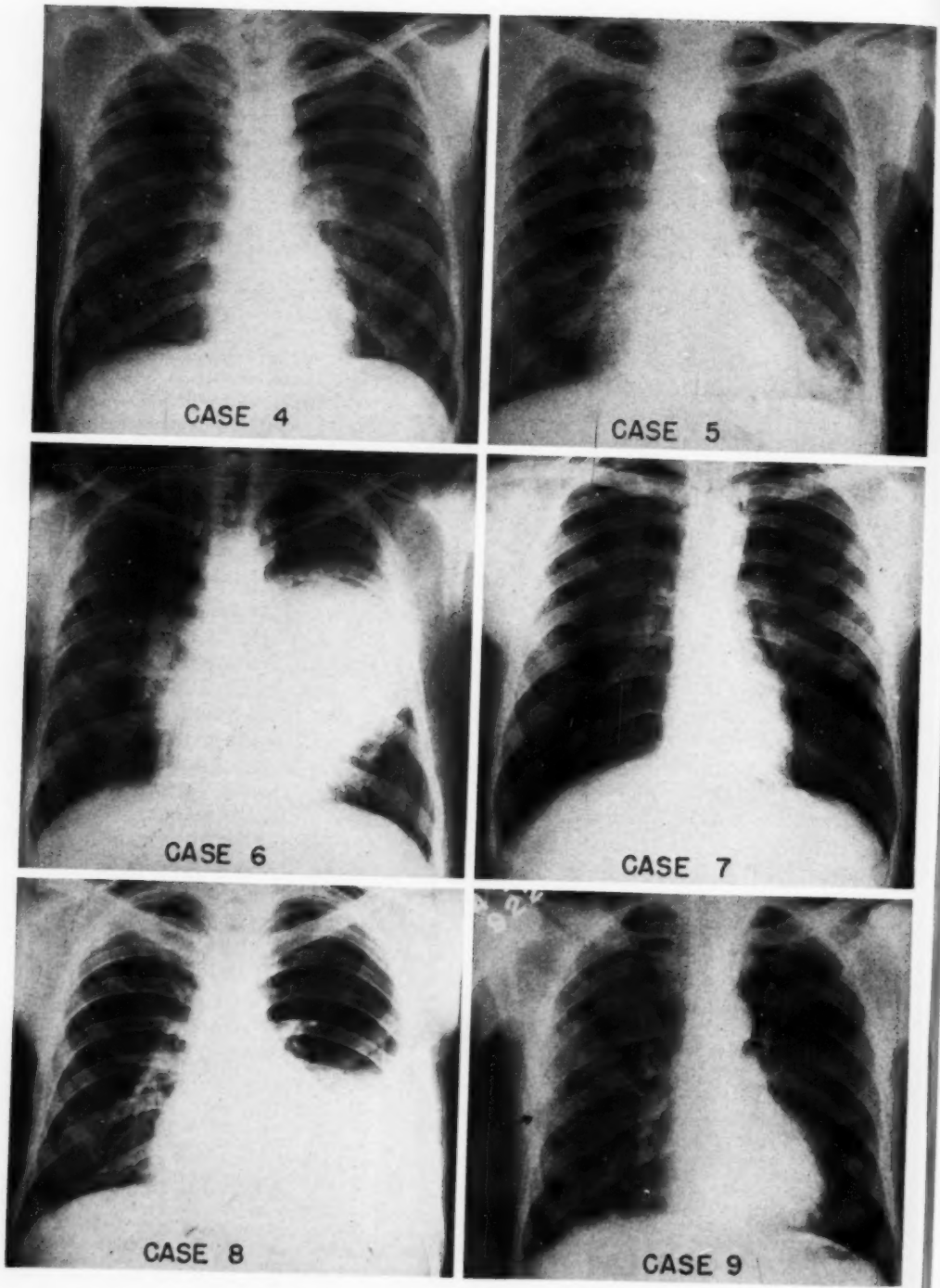


Figure 2 (Legend at foot of opposite page)

total number of such cases in this series was 3.

CASE 1: A 34-year-old white male underwent a subtotal gastrectomy for a gastric lesion which histologically proved to be Hodgkin's disease. Ten months later he died of massive bleeding from the upper gastro-intestinal tract. Study of the chest (Fig. 1, Case 1), made shortly before death, disclosed nodal masses in the right paratracheal and right hilar regions, as well as in the pulmonary parenchyma adjacent to the lower pole of the right hilus. These findings were confirmed at autopsy.

The pulmonary lesion, on the other hand, may appear as an irregular parahilar mass, extending in a radiating or linear fashion into the adjoining pulmonary parenchyma. In more advanced stages, the lesion may present an appearance indistinguishable from that observed in bronchogenic carcinoma. Cavitation may occur as a result of tissue necrosis, and the resulting parahilar abscess cavity may simulate putrid abscess, tuberculous disease, or bronchogenic carcinoma. The total number of such cases was 2.

CASE 2: A 27-year-old white male with a three-year history of cervical Hodgkin's disease had a left parahilar mass which infiltrated the contiguous parenchyma of the left upper lobe (Fig. 1, Case 2). Following irradiation (1,800 r tumor dose), there occurred marked regression of the lesion, with only minimal residual fibrosis after a two-year follow-up.

CASE 3: A 26-year-old white male gave a history of pains in the right chest, cough, and fever of two months duration. Initial roentgenograms of the chest disclosed a right parahilar mass, with a central cavity best demonstrated in the oblique position (Fig. 1, Case 3*a*). Subsequent study, six weeks later, showed extension of the disease with obscuration of the previously noted cavity (Fig. 1, Case 3*b*). Detailed investigative studies proved fruitless. Exploration disclosed a tumor of the right side of the mediastinum with invasion of the right upper lobe. A diagnosis of Hodgkin's disease was made histologically.

Intensive irradiation (3,000 r tumor dose, through two portals) caused marked regression of the mass (Fig. 1, Case 3*c*), with corresponding clinical response. After a six-month remission, pain in the chest and dyspnea recurred, with extending disease evident in the right upper lobe (Fig. 1, Case 3*d*). A second course of irradiation was cautiously begun, *via* portals angulated to avoid previously exposed skin. Improvement was prompt, and after a tumor dose of 2000 r, the patient became asymptomatic. No concomitant roentgen response was noted. Death occurred six months later from extensive amyloidosis, without return of pulmonary manifestations.

Comment: Cases 2 and 3 represent successive stages of a similar process of invasion of the pulmonary parenchyma in the presence of mediastinal nodal disease. The hazards to which patients with this type of complication are exposed are graphically illustrated in the serial studies of Case 3 (Fig. 1). Furthermore, the bizarre evolution of this case, from the initial non-specific cavitary appearance to the terminal development of a dense irregular opacification of the right upper lobe, is representative of the difficulties in diagnosis and management which may confront the radiologist. Only the immediate and persistent favorable clinical response to therapy elimi-

Fig. 2. Case 4: Peribronchial lymphatic extension. Roentgenogram taken one month prior to death. Innumerable small rounded densities are present, especially in the right lower lobe. Autopsy showed large nodular lesions in the right lower lobe.

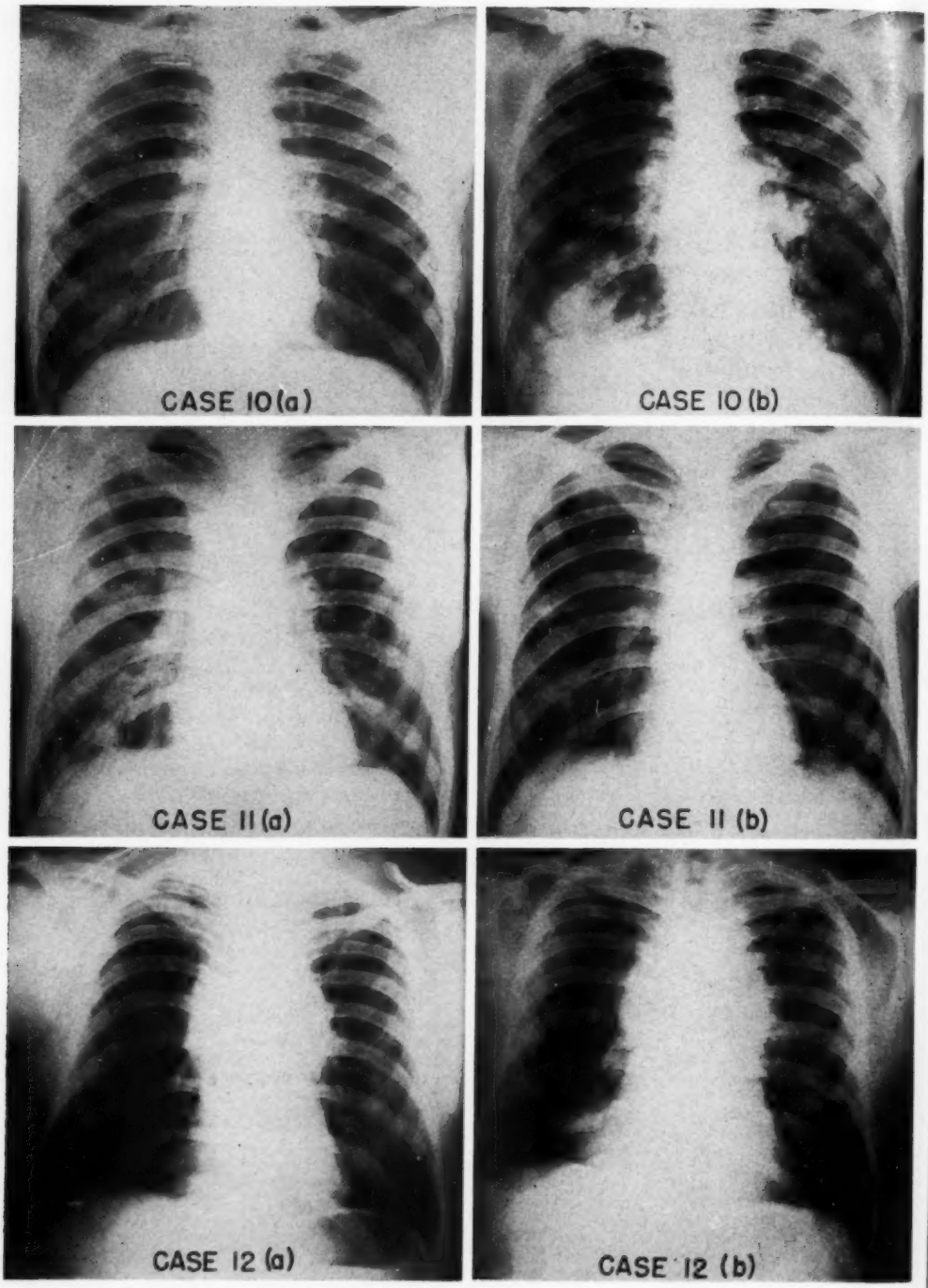
Case 5: Peribronchial lymphatic extension. This patient was treated five months previously for marked mediastinal widening with complete relief, but returned with syndrome of mediastinal compression. A lacework of feathery densities along the left border of the heart is present, with confluence of lesions in the left base, simulating basilar pneumonitis. The truncal markings in the right base are markedly increased. Autopsy one month later showed many Hodgkin's nodules throughout both lung fields, diagnosed histologically as Hodgkin's granuloma.

Case 6: Massive homogeneous infiltrate. A massive homogeneous density is noted in the lower portion of the left upper lobe in an 18-year-old white male, known to have Hodgkin's disease for three years. Smaller, confluent lesions are present in the right mid-lung field.

Case 7: Solitary circumscribed nodule. Follow-up chest study showing a small solitary circumscribed nodule, not previously present, in a plane corresponding to the 4th left anterior space. Unchanged in six months follow-up. Sputum negative.

Case 8: Solitary nodule in presence of extensive parenchymal disease elsewhere. Follow-up roentgenogram of patient with known Hodgkin's disease of the left base, revealing a circumscribed nodule in the 4th right anterior interspace. Autopsy several months later demonstrated widely disseminated nodular lesions, histologically described as Hodgkin's disease.

Case 9: Multiple diffuse bilateral nodules. Nodular lesions in the right lower lung field and in the apical region of the heart. An irregular infiltrate is noted in the right upper lobe. Arrow points to destruction in the 6th right posterior rib with soft-tissue mass evident.



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nated the possibility of radiation pneumonitis. The absence of any significant clearing in the roentgenogram of the chest favored the diagnosis of actual parenchymal infiltration rather than atelectasis due to nodal compression of a bronchus. Cavitary lesions in Hodgkin's disease of the lung have been reported by Weber, Claus and Dvorak, cited by Vieta and Craver. In addition, Versé reported 8 such cases, Castex *et al.* 2 cases, Alix y Alix 2 cases, Perrier 5 cases, and, finally, Vieta and Craver encountered 3 instances of cavitation in their series.

II. Peribronchial or Endobronchial Infiltrates in the Presence of Mediastinal Nodal Disease: Gray (8), in describing the lymphatic network of the lungs, mentions a superficial plexus beneath the pulmonary pleura and a deep plexus which accompanies the branches of the pulmonary vessels and the arborizations of the bronchi. In the case of the larger bronchi, the deep plexus consists of two systems, one, submucous, beneath the mucous membrane, and another, peribronchial, outside the walls of the bronchi. In the presence of mediastinal nodal disease, the lymphatic channels of either the peribronchial or endobronchial plexus, or both, may be involved by retrograde extension. There may also be a degree of concomitant involvement of the other structures closely contained in the supporting connective tissue.

By far the more frequent occurrence is the spread of disease along the peribronchial lymphatics. This is revealed radiographically by streaking linear or feathery densities which follow the bronchovascular distribution. Occasionally, the resulting roentgen appearance is identical with that seen in lymphangitic carcinomatosis. This latter form will be discussed under Group V. More often, the distribution of the peribronchial spread is limited to the medial aspect of one or both lower lung fields and the appearance is in no way distinctive. The total number of such cases in our series was 4.

CASE 4: A 26-year-old white male with Hodgkin's disease of seventeen months duration, previously treated for massive mediastinal enlargement, was admitted for ascites, jaundice, and other evidence of progressive liver disease. Routine roentgen study of the chest (Fig. 2, Case 4) revealed innumerable punctate densities, predominantly in the right lower lung field, apparently following the distribution of the bronchovascular structures. The patient died one month later, and autopsy disclosed well defined nodular lesions attaining 4 cm. diameter on the pleural and cut surfaces of the right lower lobe.

CASE 5: A 47-year-old male, treated in October 1947 for a superior mediastinal obstruction due to proved Hodgkin's disease, returned five months later with recurrence of dyspnea and obstruction. Roentgenograms at the time of his second admission, February 1948, disclosed slight mediastinal widening in addition to a lacework of feathery densities along the entire length of the left cardiac border (Fig. 2, Case 5). The confluence of the lesions in the left base simulated a basilar pneumonitis. Death ensued from progessive pulmonary disease, and autopsy revealed frank nodular Hodgkin's tissue in both bases, more pronounced on the left.

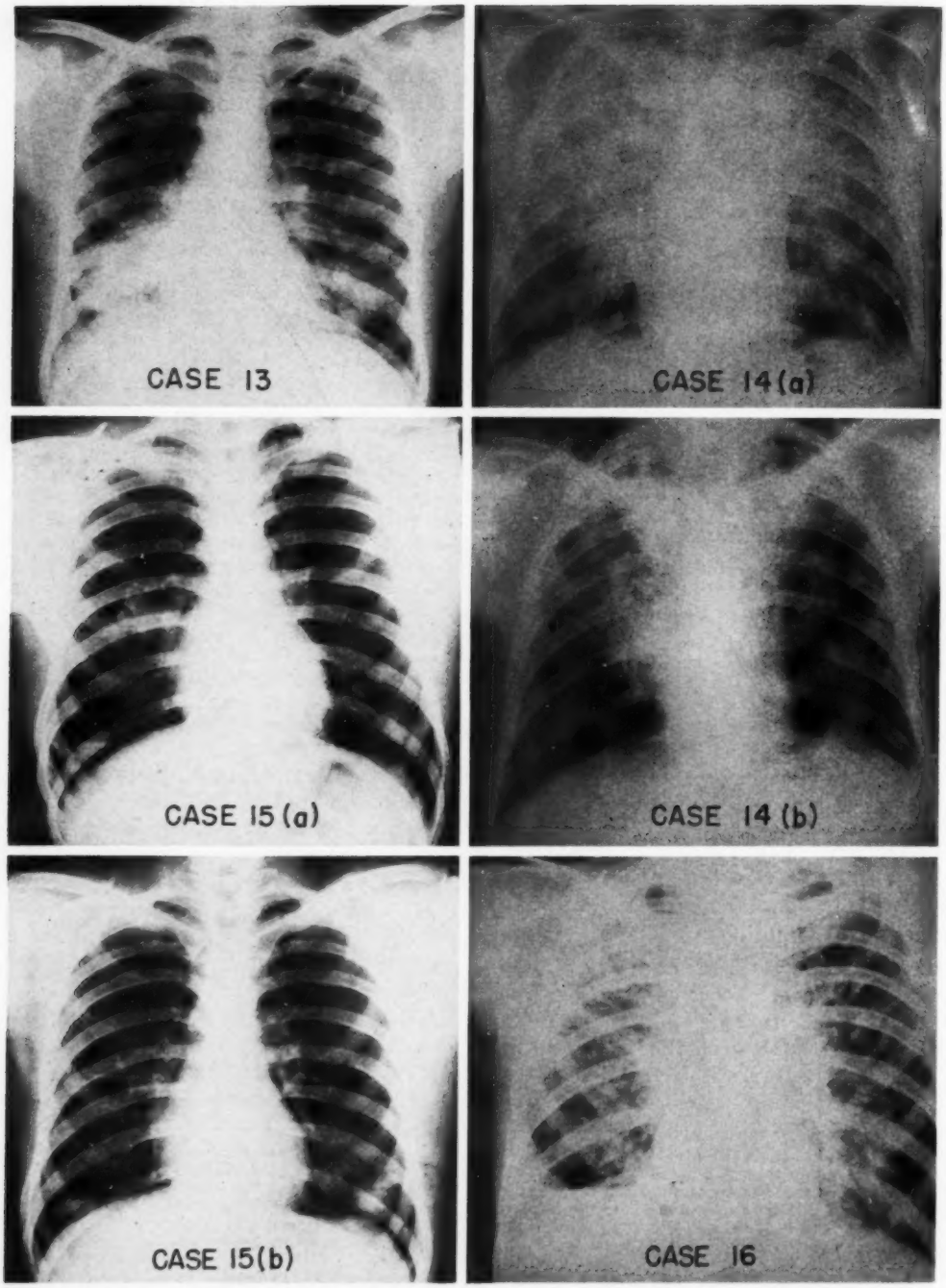
The endobronchial type of lesion has not been encountered in this clinic. Granulomatous lesions originating in the submucosal lymphatics of the bronchi and giving rise to intraluminal proliferations or ulcerations have been described by Soulas (19), Perrier (16), Moolten (15) and Vieta and Craver (23), who submitted five cases of this type.

III. Massive Homogeneous Infiltrates—So-called "Lobar Infiltrates"—Accompanying Varying Degrees of Mediastinal Nodal Disease: These cases are frequently seen

Fig. 3. Case 10: Multiple circumscribed nodular lesions. *a*. Roentgenogram of October 1946, showing several nodular lesions in the right paracardial region. *b*. Roentgenogram of June 1947, demonstrating the striking nodularity of the pulmonary lesions which have increased in number and size.

Case 11: Multiple circumscribed nodules. *a*. Roentgenogram of October 1945, showing nodular lesions throughout both lung fields. *b*. Roentgenogram dated June 1946, showing response to radiation delivered to trunk (for extensive involvement of the spine). Marked regression of the nodular lesions, especially noted on the left side.

Case 12: Multiple nodular lesions with cavitation. *a*. Roentgenogram taken October 1948, showing marked mediastinal enlargement. Numerous nodular lesions noted throughout both lungs. *b*. Examination one month later, showing distinct progression in the size of the individual foci.



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for the first time as large homogeneous opacifications of an entire or greater part of a lobe. Under these circumstances, the mode of evolution of these massive lesions is not readily determinable. However, serial study in several cases in this series clearly demonstrates the progressive evolution of these "lobar" lesions from smaller coalescent foci. Two such cases were seen.

CASE 6: An 18-year-old white male had been treated for three years for Hodgkin's disease. Follow-up routine fluoroscopy demonstrated a massive shadow occupying the lower half of the left upper lobe (Fig. 2, Case 6). Radiotherapy resulted in marked temporary regression, with recurrence one year later. The patient died twenty-two months after the known onset of pulmonary disease.

IV. Lobular Infiltrates, Accompanying Varying Degrees of Mediastinal Nodal Disease: (1) Punctate and/or mottled densities involving a variable segment or segments of lung, usually basilar, unilateral or bilateral (6 cases): This type of involvement is a more focal manifestation of involvement than that described under Peribronchial Infiltrates (*II*). The diseased areas resemble those in Cases 4 and 5, except for their limited extent and apparent separation from hilar or mediastinal areas. With therapy, these lesions undergo varying degrees of resolution. Otherwise, they are in no way to be differentiated from focal areas of bronchopneumonia of bacterial or viral origin.

(2) Circumscribed nodular densities (12 cases): Case 7 represents (*a*) the solitary, isolated density.

CASE 7: A 26-year-old white male was treated for mediastinal disease twenty-six months prior to this study. The presence of a solitary circumscribed nodule in the left anterior (4th) interspace was observed in June 1948 (Fig. 2, Case 7). The status of this lesion has remained unchanged in six months of follow-up. Investigation for tuberculosis is negative.

Case 8 represents (*b*) the solitary density in the presence of extensive parenchymal disease elsewhere.

CASE 8: A 26-year-old white male had been intermittently treated for Hodgkin's disease of the peripheral nodes for the past fifty months. Examination in September 1947 (Fig. 2, Case 8) showed a left pleural effusion, as well as a nodular infiltrate in the right 4th anterior interspace. Subsequent studies demonstrated bilateral multiple nodular lesions, confirmed at autopsy November 1947.

(*c*) Multiple, diffuse, bilateral (ultimately coalescent) densities are illustrated by the following cases:

CASE 9: A 44-year-old white male gave a four-month history of pain in the right chest. A diagnosis of bronchogenic carcinoma had been made elsewhere. Studies in this hospital (Fig. 2, Case 9) revealed a zone of irregular linear densities in the base of the right upper lobe, destruction of the 6th posterior rib on the right side, and innumerable nodular densities. A cervical node biopsy was positive for Hodgkin's disease.

CASE 10: A 22-year-old patient was ill with Hodgkin's disease for twenty months. In October 1946, a roentgenogram of the chest (Fig. 3, Case 10*a*) revealed nodular lesions in the right paracardiac region. Because of extensive roentgen therapy given elsewhere, HN2 was employed with good symptomatic results but pulmonary disease progressed (Fig. 3, Case 10*b*). The patient died in September 1947.

CASE 11: A cervical lymph node biopsy established a diagnosis of Hodgkin's disease in a 23-year-

Fig. 4. Case 13: Coalescent nodular lesions. The patient was noted to have several nodular lesions in the left lower lobe a year earlier. At present there is progressive coalescence of nodular lesions, especially noted in the right lower lung.

Case 14: Multiple coalescent nodular disease with response to therapy, in 27-year-old white male with a six-year history of Hodgkin's disease. *a*. Examination April 1947 revealing for the first time an extensive, bilateral, coalescent nodular lesion. *b*. Roentgenogram made following three courses of HN2, with dramatic clinical response. Remission was followed by abrupt recrudescence and death.

Case 15: Multiple confluent irregular foci. *a*. Roentgenogram dated August 1947, showing a focal area of involvement in each lung. Comparison with study of one year previously reveals extension of both lesions in the right lung. The left lower lung disease is noted for the first time. *b*. Roentgenogram dated March 3, 1948, demonstrating marked regression of the lesion of the right mid lung. The remaining foci show no appreciable change. Follow-up chest studies (June 1948) indicated renewed activity of pulmonary lesions. Present duration of pulmonary disease: thirty months.

Case 16: Diffusely disseminated foci of Hodgkin's (ultimately coalescent). Initial study of the chest showing innumerable widely scattered focal areas of involvement simulating the roentgen image observed in extensive inflammatory or mycotic infections or widespread metastases.

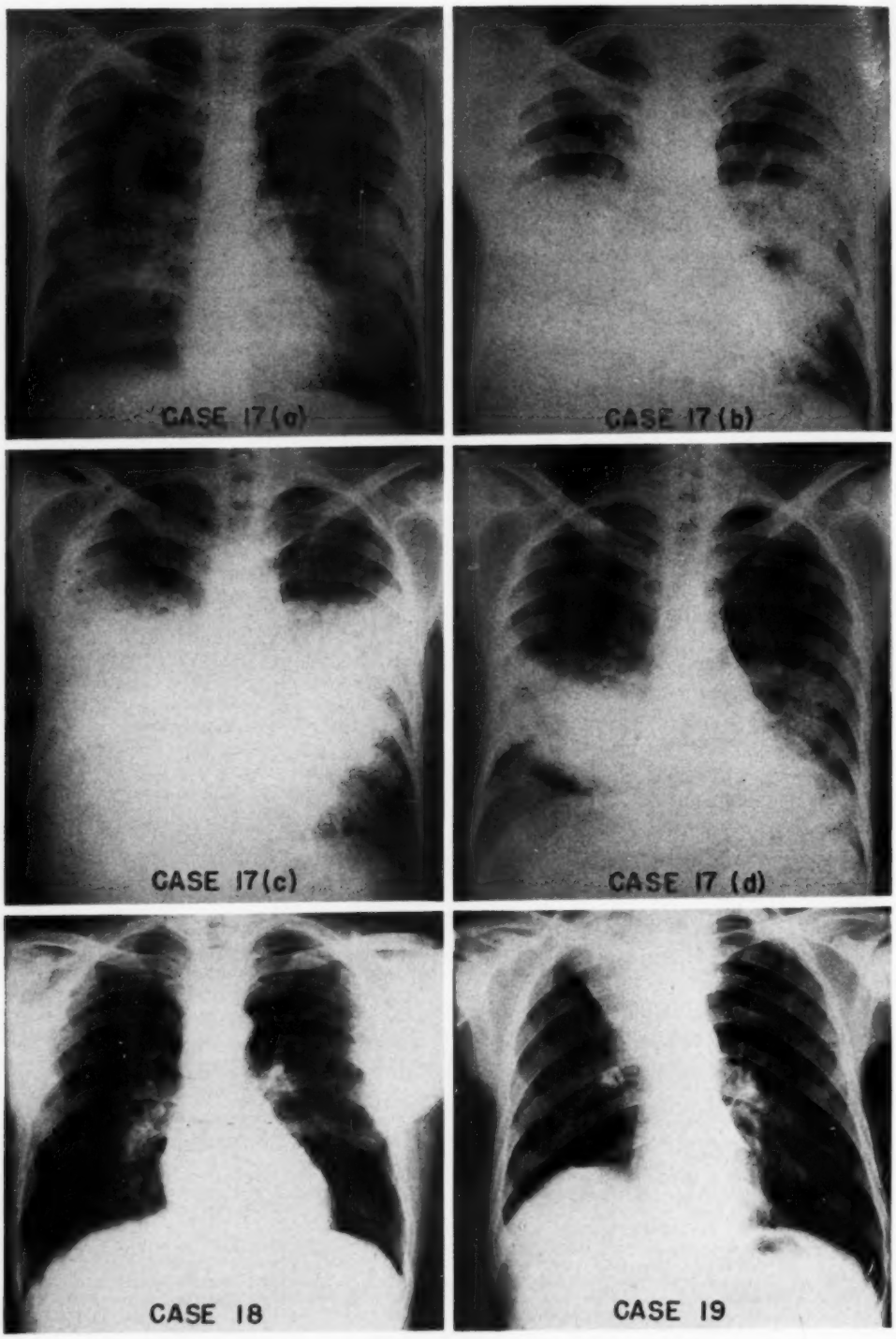

Figure 5 (Legend at foot of opposite page)

old male. In October 1945, bilateral nodular lesions were discovered radiographically (Fig. 3, Case 11*a*). A very brief course of irradiation caused marked regression of clinical and roentgen manifestations (Fig. 3, Case 11*b*). In April 1947, there occurred recrudescence of disease and death ensued shortly thereafter.

CASE 12: A 32-year-old male was treated twice within fifteen months for severe mediastinal obstructive episodes, relieved by roentgen therapy. In October 1948, he suffered a third such episode and chest study (Fig. 3, Case 12*a*) revealed recurrence of massive mediastinal widening and multiple scattered nodular densities, which showed rapid expansion within one month (Fig. 3, Case 12*b*). Radiation was ineffective, but some relief was obtained with HN2. Shortly thereafter, however, the patient succumbed to a final crisis of obstruction. Roentgenograms before death demonstrated frank cavitation within the nodular lesions.

CASE 13: A 23-year-old white male, after one year of peripheral manifestations of Hodgkin's disease had several nodules in both lung fields. Despite roentgen therapy, there was progressive coalescence of lesions, especially in the right lower lung field (Fig. 4, Case 13).

CASE 14: A 27-year-old white male had known Hodgkin's disease since April 1940. Roentgen study of the chest in April 1947 revealed extensive bilateral nodular lesions involving the upper two-thirds of both lungs (Fig. 4, Case 14*a*). Three courses of HN2 resulted in striking clinical and roentgen improvement (Fig. 4, Case 14*b*). Relapse and death occurred in August 1947.

(3) Confluent irregular densities (3 cases) may be (*a*) solitary, (*b*) multiple, or (*c*) widely disseminated with ultimate coalescence (Case 16).

CASE 15: A 26-year-old white male had Hodgkin's disease since December 1945. In July 1946 a solitary irregular lesion was observed in the right lower lung field. By August 1947, confluent densities were noted in the right lung, as well as in the left base (Fig. 4, Case 15*a*). A 2,000 r tumor dose to each of three fields caused regression only of the right mid-lung field lesion (Fig. 4, Case 15*b*). There has since been some increase in pulmonary pathology in the right base but the patient continues asymptomatic and is under observation because of extensive osseous disease.

CASE 16: A young white male was admitted to the hospital with severe respiratory symptoms. Except for a positive biopsy, little pertinent information is available. A single roentgen study of the chest (Fig. 4, Case 16), dated August 1947, showed an extensive confluent type of lobular involvement of both lungs. The patient was transferred elsewhere at own request.

Comment: The incidence of the nodular type of Hodgkin's infiltrate in this series is unusually high. Vieta and Craver estimated that the nodular form of the disease occurred in 5 per cent of their cases. Wolpaw, Higley, and Hauser (25) reported two instances of nodular lesions in their series of 58 cases of parenchymal infiltrates. Wessler and Greene described 4 cases of isolated nodules. In our series, 12 out of 35 cases exhibited nodular lesions.

Moolten believed that this type of nodular lesion does not expand and hence could be differentiated from metastatic carcinoma. Cases 4, 5, and 12 in this series illustrate the rapidity with which expansion may occur. Cases 4 and 5 are examples of rapid growth which may take place terminally.

Case 12 demonstrates a rare type of multiple cavitary lesions occurring within nodular infiltrates. Yamasaki, cited by Vieta and Craver, described multiple small cavities formed by fusion of caseating nodules.

V. Generalized Dissemination: (1) True miliary Hodgkin's disease is a very rare

Fig. 5. Case 17: Bilateral symmetrical localized lymphatic dissemination, with "butterfly" configuration, showing progressive transformation into coalescent nodular disease and the ultimate development of massive "lobar" lesions responding to therapy. *a*. Roentgenogram of chest dated February 1948, revealing a reticular infiltration of both mid-lung fields producing a granular density of "butterfly" distribution. This appearance which is frequently loosely called "interstitial pneumonitis" represents involvement of the lymphatic channels with early proliferation of the perilymphatic lymphogranulomatous foci. *b*. Film dated August 1948 revealing progression of the disease in both lungs. The coalescent nodular appearance of the lesion in the left upper lobe is apparent. *c*. Further extension of the disease (October 1948) has now produced homogeneous opacification of large segments of each lung. There is a concomitant pleural effusion. *d*. Marked regression of the disease following HN2, especially in the left lung.

Case 18: Generalized dissemination (lymphangitic type). Roentgenogram taken one month after a previously negative study. The lungs are studded with miliary nodules. The linear densities extending to the periphery of the chest are reproduced with difficulty. This patient died in one month.

Case 19: Massive atelectasis in a 47-year-old patient with Hodgkin's disease for four and a half years, admitted with severe amyloidosis in April 1947. Routine study of the chest shows massive atelectasis of the right upper lobe. Previous studies showed a large right paratracheal mass.

type of generalization represented by the presence of widespread symmetrically distributed miliary lesions, indistinguishable from a miliary tuberculosis. This form of the disease was not observed in this clinic.

(2) Lymphangitic dissemination is the more frequently observed type of generalized pulmonary dissemination. In mode of occurrence and appearance the lesions are identical with those of lymphangitic carcinomatosis, or so-called "miliary carcinosis," and of miliary sarcoid. There is retrograde permeation of the lymphatic structures, which are opacified and appear as linear densities when projected in the plane of their long axes, and as miliary nodules when visualized on end. Ackerman and del Regato (1) state that it is not unusual for the microscopic examination to demonstrate tumor actually plugging the lymphatics in neoplastic dissemination. Two cases of lymphangitic dissemination occurred in our series.

CASE 17: A 28-year-old white male, with Hodgkin's disease of one year duration was noted, in February 1948, to have a reticulonodular infiltrate, "butterfly" in distribution, involving both mid-lung fields (Fig. 5, Case 17*a*). Despite therapy, including a course of HN2, there was no change in the condition. In August 1948, a coalescent nodular lesion was reported in the left lung field (Fig. 5, Case 17*b*). Further study, in October 1948, disclosed marked extension of the process. The lesion now appeared *lobar* in character (Fig. 5, Case 17*c*). Retreatment with HN2 at this time produced notable regression (Fig. 5, Case 17*d*).

Comment: The sequence of radiographic studies in this case illustrates one mode of development of so-called lobar lesions in Hodgkin's disease. From an initial peribronchial lymphatic process there ultimately evolved progressively enlarging foci of granulomatous tissue, at first nodular in appearance, and finally, as a result of coalescence, lobar in distribution.

The original butterfly distribution of the disease simulated the roentgenographic appearance observed in certain states of increased pulmonary vascular permeability such as have been reported in inhalation poisoning and in toxic and allergic manifestations.

CASE 18: A 47-year-old white male gave a history of cervical Hodgkin's disease of two years duration. Readmission study, July 1944, was not remarkable. A repeat examination in August 1944 revealed a diffuse studding of the entire pulmonary parenchyma with miliary elements (Fig. 5, Case 18). There was likewise pronounced symmetrical prominence of the linear markings. Death occurred in one month. No therapy was feasible.

Comment: The roentgen appearance of the pulmonary lesions in this instance is identical, as we have stated, with that observed in lymphangitic carcinomatosis and in miliary sarcoidosis. Perrier described 9 cases of miliary involvement, Castex *et al.* one such case, and Vieta and Craver contributed three cases.

Miscellaneous: To terminate our presentation of cases, it is felt that the following is of interest since it illustrates a type of complicaton which is not infrequent.

CASE 19: A 47-year-old white male patient with a history of Hodgkin's disease of four and a half years was admitted to this hospital in April 1947, with severe amyloidosis. He died shortly after admission. An antemortem roentgenogram of the chest (Fig. 5, Case 19) disclosed a massive atelectasis of the right upper lobe. A review of previous studies showed a large right paratracheal node which had been present for two years.

Comment: Similar cases of massive atelectasis have been reported by Levy (14), Hardin (9), and Castex *et al.* Most often, the atelectasis is a result of extrinsic compression of a bronchus by a large node. Reference has already been made to the report of Moolten, whose patient demonstrated atelectasis as a result of endobronchial obstruction.

DISCUSSION

The most frequent type of parenchymal lesion encountered in this series was the lobular infiltrates (Group IV), of which there were 23 cases. In 17 instances the parenchymal lesion appeared as a localized focus or foci, roentgenographically identical with the metastatic foci associated with known hematogenous dissemination in malignant neoplasms of the testis, kidneys, thyroid, etc. In 5 cases, the pulmonary involvement was present from the known

onset of the disease. In 3 of these cases, Cases 3 and 9 and one other, the presenting pulmonary manifestations, as well as the clinical and roentgen findings, prompted a diagnosis of bronchogenic carcinoma. These cases represent a predominantly pulmonary form of Hodgkin's disease, rather than primary pulmonary disease which has rarely, if ever, been demonstrated. Two of our cases, Case 3 and Case 12, manifested the cavitary form of Hodgkin's disease.

THERAPEUTIC MANAGEMENT

Prior to January 1947, radiation therapy was the sole agent employed by this department in the treatment of Hodgkin's disease. It is the policy of our Radiation Clinic to treat actively all lesions of the lung ascribable to Hodgkin's disease, provided that they are symptomatic or progressive. Occasionally, a small lesion is kept under observation (Case 7). The pulmonary focus is cross-fired through multiple small portals, with special beam-angulation and localization devices. Treatment is given daily, the total daily tumor dose being 150 to 200 r, until a provisionally scheduled dosage is attained, usually 1,500 to 2,000 r, at which level the course of therapy is re-evaluated on the basis of the response noted. If necessary, irradiation is continued to a total tumor dose of 2,500 to 3,000 r. The technical factors usually employed are: 200–220 kv., 15–20 ma., Thoraeus filter (equivalent to 2 mm. Cu h.v.l.) and 50 cm. target-skin distance. Radiation sickness, when it occurs, is effectively controlled by the use of desoxycorticosterone acetate, a synthetic adrenal cortical hormone.

In January 1947, HN2 (nitrogen mustard) was employed in a research study in collaboration with the National Research Council. A complete report of our cumulative experience with this agent has been published elsewhere (18). Briefly, it may be stated that, in this Radiation Clinic, HN2 is employed as a systemic adjunct to radiation in those cases for which the latter is no longer advisable or feasible, because of radioresistance or advanced generalization of the disease. The drug is given intravenously in doses of 0.1 mg. per kilogram of body weight for four consecutive daily doses and repeated at intervals of no less than four weeks, if necessary.

EVALUATION OF RESULTS OF THERAPY

Of the 35 cases reviewed in this paper, 12 received radiation only. In 3 of these (among them Case 2) the response was considered excellent, because of prompt, marked, and persistent regression of the pulmonary lesion, and concomitant symptomatic relief. In 4 cases (including Cases 3, 6, and 15) the response was judged good, because of a clinical and/or response of some duration, six months to one year. In 5 cases (including Cases 9 and 13) the response was slight or nil.

Ten cases received nitrogen mustard therapy. Eight patients responded in a manner considered excellent because of marked clinical improvement, clearing of pleural effusions (Case 8) and pericardial effusions and regression of parenchymal infiltrates (Cases 14 and 17). In 2 cases, clinical response was judged good but no radiographic evidence of improvement was demonstrable (Cases 10 and 12).

In an analysis of the lesions responding to either radiation therapy or nitrogen mustard, one finds instances of favorable response in a majority of the types classified, with the single exception of the lymphangitic type of dissemination. There is no logical means of predicting the responses of a specific lesion to therapy. Thus in Case 11 multiple circumscribed nodules responded indirectly to irradiation delivered only to the trunk and supraclavicular regions. Jacox, Peirce, and Hildreth (13) reported a case of multiple nodules which responded to multiple transfusions. Vieta and Craver, Perrier, and Castex *et al.* reported demonstrable response to direct irradiation in cases of circumscribed nodules. Wolpaw *et al.*, however, observed a similar case which failed to respond. Even in the same patient one pulmonary focus may respond to direct

irradiation whereas a concomitant lesion of a similar kind elsewhere in the lung, similarly treated, may show no change. Case 15 received a 2,000 r tumor dose to each of three separate pulmonary infiltrates. Only one lesion underwent appreciable regression.

These observations are in agreement with the views of Desjardins (6), who indicated that the radiosensitivity of pulmonary lesions in Hodgkin's disease is distinctly less than that of the peripheral and mediastinal foci of involvement. Nevertheless, the effectiveness of radiation therapy in achieving a notable regression of pulmonary disease in a significant percentage of cases is incontestable. The dramatic, though brief, response to HN2 (average duration of remission, forty-five days) in gravely ill patients warrants the fullest exploitation of the drug within recognized schedules of dosage.

PROGNOSTIC SIGNIFICANCE OF THE DEVELOPMENT OF PULMONARY LESIONS

Of the 35 patients with pulmonary Hodgkin's disease, just reviewed, 29 are now dead. Eleven died of predominantly pulmonary disease. Of these 11, only 3 lived more than six months. One patient (Case 6) lived twenty-two months, one patient eighteen months, and one patient (Case 8) fourteen months after the onset of the pulmonary disease.

Six patients are alive with pulmonary involvement. One is in the fifth year of illness, five years after the onset of pulmonary lesions, at present controlled by radiation. One (Case 2) is in the fifth year of illness, two years after the onset of pulmonary lesions, at present controlled by radiation. One (Case 15) is in the third year of illness, two and a half years after the onset of pulmonary lesions, at present partially controlled by radiation. Three patients are alive less than six months after the onset of pulmonary lesions.

In general, the development of pulmonary lesions, other than an isolated focus (Case 7), is evidence of a more aggressive disease, a fact which must further darken the prognosis. No other generalization regarding the prognostic implication of the occurrence of pulmonary lesions appears warranted. The extent, kind, and site of pulmonary involvement in the past have been considered indices of gravity of the disease. Even these factors are not consistently reliable. Thus, the patient of Alix y Alix lived more than three years with a large cavitary lesion. One of our series (Case 3) lived two years after the onset of a cavitary lesion and died of amyloidosis. Another (Case 6) lived two years after the onset of a massive "lobar" lesion. A third (Case 15) has survived two years and a half with moderately extensive pulmonary involvement which partially responded to therapy. In conclusion, it may be stated that the development of pulmonary lesions in Hodgkin's disease offers no consistent prognostic significance.

SUMMARY

(1) A survey of 35 cases of pulmonary parenchymal lesions in Hodgkin's disease has been reported in order to demonstrate the remarkable variability of their roentgen appearance.

(2) There have been presented representative cases of the type which are roentgenographically indistinguishable from tuberculosis, pulmonary abscess, peribronchial inflammatory disease, lobar pneumonia, metastatic disease of the lungs of both nodular and lymphangitic type, mycotic infection, and miliary sarcoidosis.

(3) The incidence of the nodular forms of Hodgkin's disease of the lungs has been discussed.

(4) The therapeutic management, both by radiation and HN2, has been outlined.

(5) The prognostic implication of the development of pulmonary lesions in Hodgkin's disease has been reviewed.

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SUMARIO

Enfermedad de Hodgkin en el Pulmon: Aspecto Roentgenológico y Manejo Terapéutico

Este estudio de 35 casos de lesiones del parénquima pulmonar en la enfermedad de Hodgkin tiene por objeto demostrar la notable variabilidad del aspecto roentgenológico de las mismas. Estas corresponden a cinco grupos principales.

Comunícanse casos representativos de las varias formas, señalando las semejanzas roentgenográficas a la tuberculosis, el absceso pulmonar, la enfermedad inflamatoria peribronquial, la neumonía lobular, las metástasis neoplásicas de forma tanto nodular cuanto linfangítica, las micosis y la sarcoidosis miliar.

La serie comunicada reveló una frecuencia inusitada de la forma nodular de infiltración: 12 de los 35 casos.

Discútense sucintamente la radioterapia y el empleo de las mostazas de nitrógeno, habiéndose observado casos de respuesta favorable a ambos agentes en la mayoría de los tipos enumerados, con excepción de la diseminación linfangítica. No hay forma de anticipar la respuesta de una lesión específica a la terapéutica.

En general, la aparición de lesiones pulmonares de Hodgkin, aparte de un foco aislado, constituye signo de agresividad, sin que esté justificada ninguna otra generalización relativa a las connotaciones pronósticas de la invasión pulmonar.

Convulsive Fractures of the Dorsal Spine Following Electric-Shock Therapy[1]

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ALTHOUGH FRACTURES of the dorsal spine following convulsive seizures of tetanus have been known since 1907 (1) and a great number of publications regarding metrazol fractures have appeared since 1938 (2), relatively little has appeared in the English and American literature regarding spine fractures resulting from electric-shock therapy.

In 1942, Worthing and Kalinowsky (3) reported, on the basis of their private communications with many clinics which at that time were using electric-shock therapy, that electric convulsive fractures were about one-fourth as frequent as metrazol fractures. The incidence of fractures in their own series of cases was 10 per cent. Barrett, Funkhouser, and Barker (4) thereafter studied twenty selected cases each, associated with electric shock, metrazol therapy, and epilepsy and twenty cases in non-convulsive patients, and indicated that the fractures in these four groups looked very much alike.

In 1946, Huddleson and Gordon (5) reported briefly a survey of 252 patients who were studied for possible radiographic abnormalities of the spine which might predispose to fracture following electric-shock therapy, and concluded that the abnormalities on the pre-shock films had no significance in relation to the subsequent incidence of fractures. They noted an over-all fracture incidence of 6.3 per cent, with 4.3 per cent in normal spines, and 6.8 per cent in their "abnormal" spines. The abnormalities which they studied were listed as follows: diminished calcification and rarefaction of vertebral bodies; decreased density of vertebral disks; narrowness and haziness of intervertebral spaces; the atrophic and hypertrophic arthritides; abnormal curvatures; "miscellaneous" conditions. Another brief study of fractures due to electric-shock therapy was reported by Ferdière and Latrémolière (6) in 1946 in the French literature, and several have appeared in Italian journals (7).

No attempt will be made here to review the "metrazol" literature exhaustively. A very comprehensive study of metrazol convulsive fractures was published by Easton and Sommers (8) in 1944. Among 800 cases with a good age and sex distribution, they found an over-all incidence of fracture of 26.1 per cent—37.2 per cent in males and 16.8 per cent in females. The incidence was slightly higher in the group below twenty years of age. The average number of fractured vertebrae among those who sustained fractures was 2.6 per patient. All vertebrae were involved between the second and eleventh dorsal, inclusive, but those most often affected were the fourth, fifth, and sixth. There was no increased tendency to fracture associated with kyphosis, scoliosis, arthritis, nuclear change, or old fractures. Osteoporosis, however, appeared to predispose somewhat to fractures in that the incidence among patients with this condition was double that in the rest of the cases studied. It was also found that a patient who did not sustain a

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fracture in the first course of metrazol treatments was not very likely to sustain injury in subsequent "shock" therapy.

Following the original recommendations of Bennett (9), Easton and Sommers employed Intocostrin (Squibb), which contains 20 mg. curare per cubic centimeter, in an effort to prevent fractures. This was tried at two different institutions with an over-all diminution of the fracture incidence to 5.8 per cent from the previously reported 26.1 per cent. There was still a greater occurrence of fractures in the presence of osteoporosis. Cummins (10), in 1942, had reported a similar benefit from the use of curare, with a lowering of the incidence of fractures from 14.8 to 3.8 per cent without diminution in the therapeutic effect of the convulsive seizures from metrazol.

There appears to be general agreement that the possibility of dorsal spine fractures does not contraindicate convulsive shock therapy, in view of the debilitating diseases being treated, the asymptomatic nature of the fractures, and the possible improvement which may be obtained in the patient's general condition as the result of the treatment. It was our purpose in the present study to follow sequentially the development of electric-shock fractures of the spine beginning with their first appearance, and to attempt to correlate their occurrence with any possible factor discernible on films taken prior to shock therapy. Since curare was administered in certain instances, a study was also attempted of the efficacy of this drug in the prevention of convulsive fractures of the spine. The immediate clinical results from the treatment were also tabulated, although no special effort will be made in the present communication to evaluate the procedure on any long-term basis.

DISCUSSION OF RESULTS

Procedure: All patients who received electric-shock therapy between October 13, 1947, and June 9, 1948, were routinely studied. During this interval, 213 patients were scheduled for treatment but, as one of these was inadvertently omitted, the series numbers 212.

The neuropsychiatric department administered the shock treatments. The shocks were of 0.2 to 0.3 second duration and were repeated until a grand mal seizure resulted. The seizures lasted from twenty to sixty seconds. After convulsions had ceased, the patients were rolled from side to side in an effort to clear the bronchi of excessive secretion. They were then taken to the recovery room, where they remained from ten to thirty minutes. When curare was administered, it was given intravenously in quantities of 1 to 4 c.c., in the form of Squibb's "Intocostrin," which, as previously stated, contains 20 mg. of curare per cubic centimeter. The injection lasted one minute and there was a lapse of two minutes before the patient was shocked, to allow for the maximal effect of the drug.

The patients were partially immobilized by trained attendants, one of whom was placed at the head, a second lying lightly across the shoulders, a third lying across the thighs, and a fourth holding the feet. The attendants were trained so that the immobilization was light and not a complete restraint. A special table which promotes hyperextension of the upper dorsal spine was employed.

For all patients a postero-anterior 70-mm. microfilm of the chest, skull films, and lateral films of the dorsal spine were routinely obtained prior to the institution of the electric-shock therapy. Lateral films of the dorsal spine were taken after the first, second, third, fourth, fifth, tenth, fifteenth, and twentieth shock treatment (with exceptions to be indicated below).

The factors tabulated and studied in detail in relation to convulsive fractures are as follows:

(*a*) *Inherent character of the patients*, such as age, color, sex, and weight.

(*b*) *Previous history of injury or previous administration of convulsive shock therapy.*

(*c*) *Method of administration of the electric shock*, including electrical factors; duration of grand mal seizures; number of seizures; the doctor who administered the shock;

whether or not curare was administered, and how and when it was given.

(*d*) *Radiographic abnormalities on the control films taken prior to the present shock series*, such as anterior compression or narrowness of vertebral bodies, deforming spondylosis, osteochondrosis, osteoporosis, Schmorl's nodes, kyphosis, scoliosis, or any other pathologic findings such as interspace or joint abnormalities.

(*e*) *Radiographic abnormalities detected on the post-convulsive film series*, including character of impression or compression of a vertebral body; spinal deformity; when the abnormality first became manifest, and how it altered in appearance as time went on.

(*f*) *Objective complaints and early improvement.*

(*g*) *Efficacy of curare.*

General Statistics: Of the 212 patients constituting this series, 75 sustained shock fractures (35.4 per cent) and 192 vertebrae were involved—an average incidence of 2.56 vertebrae per patient among those sustaining fractures.

Age: For the various age categories, the ratio of those who sustained fractures to those who did not is as follows: under 20 years, 1 out of 5 cases (20 per cent); 20 to 29 years, 32 out of 102 cases (31 per cent); 30 to 39 years, 28 out of 61 cases (46 per cent); 40 to 49 years, 6 out of 18 cases (33 per cent); 50 to 59 years, 6 out of 23 cases (26 per cent); over 60 years, 2 out of 3 cases (66 per cent). The only one of these groups with a significant number of cases which exceeds the 35.4 per cent overall incidence of fracture is that of 30 to 39 years, with an incidence of 46 per cent. This particular age range is probably of importance as a predisposing factor. The overall incidence in the remaining age groups was 31 per cent. The group beyond the age of 60 is not sufficiently large for significant conclusions.

This age distribution differs from that of Easton and Sommers (8) for metrazol-shock fractures, where the only significant difference was in the group under twenty years. In age distribution of patients, however, the two series are not entirely comparable.

Sex: Since all the patients were males, no sex correlation can be drawn.

Race: Twenty-eight of the patients were Negroes and 184 Whites. Nine of the 28 Negroes sustained a fracture (32 per cent), and 66 of the Whites (36 per cent). This difference is not significant.

Relationship of Previously Narrowed Vertebrae to Incidence of Shock Fractures (Table I): A total of 80 patients had anteriorly narrowed dorsal vertebrae prior to the present shock series, *omitting cases with diagnosable remote or recent osteochondrosis*. The vertebra was considered anteriorly narrowed if its anterior measurement was less than that of the vertebra over it by 2 mm. or more. There were 139 vertebrae thus involved, with the incidence as shown in Table I. As indicated in the study of Fletcher (11) anterior vertebral wedging may not necessarily indicate previous compression fracture unless the ratio of the anterior to the posterior measurement exceeds a certain tabulated value for each vertebra. In the present series, however, all cases of anterior narrowness were considered, and this feature has been correlated with the history of previous shock therapy or injury.

Of the 80 patients who had anteriorly narrowed vertebrae on the control films, 38 suffered shock fracture (47.5 per cent) and 42 did not (52.5 per cent). *Thus, it would seem that any degree of anterior narrowness in any vertebral body increased the predilection for shock fracture. In spite of this predisposition, in only 11 cases were the previously narrowed vertebrae themselves the site of subsequent fracture.*

In analyzing further the 38 patients with anteriorly narrowed vertebrae demonstrated on control films (see Table I), who also sustained shock fractures, we find that more than one-half had had no previous injury or previous shock. A comparison with the 42 patients who had anteriorly narrowed vertebrae but did not sustain a shock fracture suggests that those with a history of previous shock therapy or injury

TABLE I: RELATIONSHIP OF HISTORY OF PREVIOUS INJURY AND/OR PREVIOUS SHOCK THERAPY TO ANTERIOR NARROWNESS OF VERTEBRAL BODIES PRIOR TO THE PRESENT SHOCK SERIES AND FOLLOWING PRESENT SHOCK SERIES

	History of Previous Injury		No History of Previous Injury		
	Previous Shock	No Previous Shock	No Previous Shock	Previous Shock	Total and Per Cent of 212
With anteriorly narrowed vertebrae on control film who sustained shock fracture	2	3	21	12	38 (17.9%)
Without anteriorly narrowed vertebrae who sustained shock fracture	0	1	31	5	37 (17.4%)
Without anteriorly narrowed vertebrae who did not sustain shock fracture	2	3	67	23	95 (44.8%)
With anteriorly narrowed vertebrae who did not sustain shock fracture	1	2	16	23	42 (19.8%)
Total	5	9	135	63	212
Per cent of 212	2.3	4.2	63.7	29.7	

Total with no previous shock	67.9%	Total with previous injury	6.5%
Total with previous shock	32.0%	Total with no previous injury	93.4%

	No. of Cases Sustaining Present Shock Fracture	Per Cent of 80	No. of Cases Without Present Shock Fracture	Per Cent of 80	Total and Per Cent of 80
Total with previous injury and/or shock with anteriorly narrowed vertebrae on control film	17	21.2	26	32.5	43 (53.7%)
Total without injury and/or previous shock with anteriorly narrowed vertebrae	21	26.3	16	20.0	37 (46.3%)
Total (all with narrowed vertebrae on control film)	38	47.5	42	52.5	80

	No. of Cases Sustaining Present Shock Fracture	Per Cent of 132	No. of Cases Without Present Shock Fracture	Per Cent of 132	Total and Per Cent of 132
Total with previous injury and/or shock without anteriorly narrowed vertebrae	6	4.5	28	21.2	34 (25.7%)
Total without previous injury and/or shock without anteriorly narrowed vertebrae	31	23.5	67	50.8	98 (74.3%)
Total (all without anteriorly narrowed vertebrae)	37	28.0	95	72.0	132

seemed slightly less likely to suffer convulsive fractures from the present series of treatments than those who had not formerly undergone such therapy.

Of the 132 patients who showed no anterior narrowing on the control films, 37 (28 per cent) sustained shock fractures and 95 (72 per cent) did not. Of 34 patients without anterior narrowing who gave a history of previous shock therapy or injury, only 6 (17.6 per cent) sustained electric-shock fractures. This group would therefore seem to be a favored one so far as the development of fractures of the spine from subsequent electric-shock therapy is concerned.

There were in all 68 patients (32 per cent) who had had previous shock, and 144 (68 per cent) who gave a definite history of no previous shock. Of the former group, only 19 (28 per cent) had shock fractures in the present series; 38.8 per cent of those with no previous shock treatment suffered spine fracture.

In summary, we may say that in patients with a history of previous shock therapy of some type, there was a slight general indisposition to develop electric-shock fractures in the present series. If anterior narrowness of a vertebral body were apparent on their control films, they were considerably more likely to have shock

TABLE II: DISTRIBUTION OF ANTERIORLY NARROWED VERTEBRAE BEFORE THE PRESENT SHOCK SERIES AS AGAINST AFTER SHOCK

Thoracic Vertebrae Number	Number of Vertebrae Narrowed Prior to Shock	Per Cent of 139	Number of Vertebrae Narrowed Following Electric Shock (in Addition to Those Prior to Shock)	Per Cent of 192
2	2	1.4	0	0
3	7	5.0	28	14.6
4	20	14.4	53	27.8
5	29	20.9	49	25.6
6	28	20.2	33	17.2
7	26	18.7	18	9.4
8	18	13.0	9	4.7
9	3	2.2	1	0.5
10	2	1.4	1	0.5
11, 12	4	2.9	0	0
Total	139	100	192	100
Total number of patients	80		75	
Vertebrae per patient	1.74		2.56	

fracture than if such narrowing were not present. In general, however, anterior narrowness could not be correlated with previous injury or shock therapy. In itself, it was the foremost factor which was correlated with a high incidence of shock fractures, although the narrowed vertebrae were not themselves usually involved.

The Relationship of Osteochondrosis to the Incidence of Fracture: Thirty-four patients (16 per cent) had evidence of previous remote osteochondrosis, with varying degrees of superimposed deforming spondylosis. Of these, only 4 suffered shock fractures, an incidence of 11.8 per cent. The incidence of fracture in the remaining group was 39.9 per cent. We can, therefore, categorically state that osteochondrosis does not predispose to shock fracture, and, in fact, may permit a notable resistance to its occurrence.

Distribution of Anteriorly Narrowed Vertebrae in Relation to the Distribution of Fractured Dorsal Vertebrae: Omitting cases of osteochondrosis in all instances, there were 139 vertebral bodies with narrowing demonstrable on the control films. T-4, T-5, T-6, T-7, and T-8 accounted for the greater number, with T-5 and T-6 representing the maximum. (See Table II.) Following electric-shock therapy, 192 vertebral bodies showed evidence of fracture. In this group, a significant increase in the narrowness incidence was noted in T-3, T-4, and T-5, with a slight increase in T-6. These four vertebral bodies accounted for 163 of the 192 fractured vertebrae (85 per cent). Thus, it can be stated that electric shock significantly affects T-3, T-4, T-5, and T-6. Fractures will also occur in T-7 in approximately 9 per cent of the cases. In only 11 instances was a previously narrowed vertebra considered the site of further fracture.

Efficacy of Curare: Curare was administered in 98 cases. There was one curare death (1 per cent). In 41 cases (42 per cent) the curare was given at the beginning and in 57 cases (58 per cent) after the beginning of treatment. The 41 patients to whom it was given initially were chosen by the neuropsychiatrists as possible candidates for fracture, primarily on the basis of debility. In the remaining 57 cases, fracture or vertebral injury was observed before curare was administered.

Whereas the over-all incidence of shock fractures was approximately 35.4 per cent, the incidence when curare was given at the beginning of treatment was 19.5 per cent (8 cases). Among 171 patients to whom curare was not administered from the beginning, this figure was nearly doubled, the incidence of fractures being 39.2 per cent (67 cases). When curare was given after the course of treatments had been started, no new fractures appeared in 12 cases (20.7 per cent), there was no progression of fractures in 6 cases (10.3 per cent). It was impossible to evaluate the

TABLE III: EFFECT OF VARIOUS FACTORS ON INCIDENCE OF ELECTRIC-SHOCK FRACTURES IN 212 CASES

Factor	Total No. Cases	Per Cent of 212	Fracture Present			
			Cases with Factor	Per Cent of Fracture Cases	Cases Without Factor	Per Cent in Group Without Factor
Moderate and severe deforming spondylosis	19	8.9	7	36.8	68 in 193	35.2
Kyphosis (not including osteochondrosis)	72	34.0	24	33.3	51 in 140	36.4
Scoliosis	19	8.9	8	44.4	67 in 193	34.9
Schmorl's nodes (not including osteochondrosis)	47	22.3	14	29.8	61 in 165	36.9
Osteochondrosis	34	16.0	4	11.8	71 in 178	39.9
White race	184	87.0	66	36.0	9 in 28	36.0
Negro race	28	13.0	9	32.0	66 in 184	32.0

efficacy of the drug in at least 13 cases (22.4 per cent).

In 27 cases (46.6 per cent), despite the administration of curare after the treatment course was begun, old fractures progressed, new fractures appeared in addition to old fractures, or new fractures appeared for the first time. More than one of these three phenomena may have appeared in a single patient. Thus, old fractures progressed in 22 of the 27 patients. Additional fractures appeared beyond previous fractures in 11 cases, and new fractures appeared for the first time in 2 cases.

Analysis of Cases With Regard to Physicians Who Administered the Shock Therapy: In general, much the same technic of shock administration was employed by all physicians. Frequently two or three physicians would be involved in the administration of a complete shock series to a single patient.

Dr. M. L. W. administered shock to 83 patients, of whom 32 suffered fracture (39 per cent). Dr. E. A. W. administered shock to 171 patients, with an incidence of fracture of 33 per cent (56 cases). Dr. C. C. administered shock to 66 patients with an incidence of fracture of 30 per cent (20 cases). Other physicians administered shock to 20 cases, 22 cases, and 6 cases, respectively, numbers too small for significant conclusions. The incidence of fracture thus did not vary materially with respect to the three physicians who administered most of the shock treatments.

Relationship of Kyphosis to Incidence of Fracture in Those Cases Without Osteochondrosis: In order to determine the presence or absence of kyphosis, a tangent was drawn to the posterior margins of the vertebral bodies of the lower dorsal spine and an average tangent was drawn along the posterior margins of the bodies of the upper dorsal spine, close to the fulcrum of curvature. When the angle thus drawn was less than 165 degrees, a kyphosis was considered to be present. Seventy-two such cases were found, in 24 of which fracture occurred (33 per cent). Thus, on the basis of this series, kyphosis cannot be considered a factor predisposing to fracture (Table III).

Relationship of Scoliosis to Incidence of Shock Fracture (Omitting Cases of Osteochondrosis): Nineteen patients had scoliosis of some degree, and 8 of these sustained shock fractures (42 per cent). This figure cannot be regarded as of significance in view of the small number of cases (Table III).

Relationship of Deforming Spondylosis to the Incidence of Fracture: Minimal deforming spondylosis is such a frequent normal finding that it can hardly be considered in this analysis. However, when small bony spurs in excess of 3 mm. were present on more than three vertebral bodies or when bridging of more than three interspaces occurred, the patients were considered to have either moderate or severe deforming spondylosis. For this analysis only those cases were included in which osteochondrosis was not present as well. There was a total of 19 patients falling into this category, 7 of whom sustained fractures (36.8 per cent). Thus, moderate or

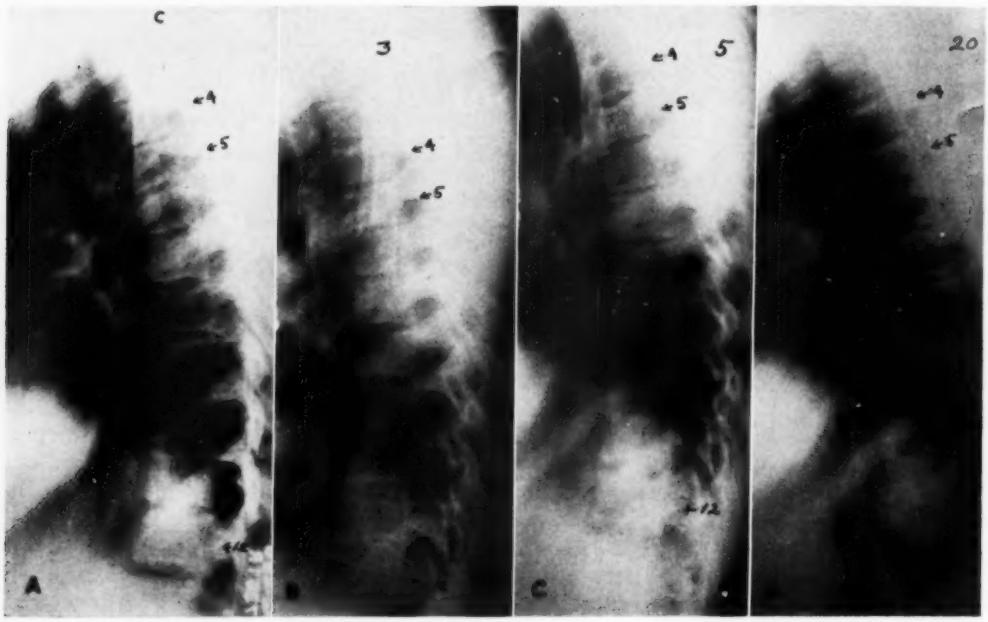

Fig. 1. First appearance and progression of electric-shock fracture.
A. Film taken prior to electric-shock therapy. Normal spine.
B. Film obtained after third electric-shock treatment, demonstrating end-plate impression, or concavity superiorly, of the fourth and fifth thoracic vertebrae.
C. Film obtained after the fifth electric-shock treatment, demonstrating further end-plate impression, slight anterior compression, and beginning sclerosis of the superior end-plates of T-4 and T-5.
D. Film obtained after the twentieth electric-shock treatment, demonstrating further sclerosis of the superior end-plates of T-4 and T-5.

severe deforming spondylosis is probably not a predisposing factor, but the number of cases is too small for accurate correlation (Table III).

Time of Discovery of Fracture: So far as possible, films were obtained in all cases after the first, second, third, fourth, fifth, tenth, fifteenth, twentieth, and final treatment. Complete series of films were available in 150 cases. In this series, the fracture was discovered after the first shock treatment in 32 cases (21 per cent); after the second shock treatment in 34 cases (22 per cent); after the third shock treatment in 31 cases (20 per cent); after the fourth treatment in 12 cases (8 per cent); after the fifth treatment in 11 cases (7 per cent); after the tenth treatment in 23 cases (15 per cent); after the fifteenth treatment in 6 cases (4 per cent); after the twentieth treatment in only 1 case.

Thus, *in slightly less than two-thirds of the cases (63 per cent) the fractures occurred within the first three shock treatments,* and in the first five treatments almost four-fifths of the fractures (78 per cent) became manifest. Less than 5 per cent appeared following the fifteenth treatment. Any preventive measure must, therefore, be instituted from the very start.

How Fractures First Made Their Appearance: A study of the 150 cases with a complete series of films available showed the first appearance of the fracture to be of the anterior compression type in 61 cases, or 41 per cent (see Figs. 1, 2 and 3); the first appearance was that of a superior end-plate impression in 51 cases (34 per cent); and an end-plate sclerosis in 4 cases (3 per cent). A combination of superior end-plate impression and anterior compression was observed in 19 cases, or 13 per cent, and a combination of superior end-plate impression and end-plate sclero-

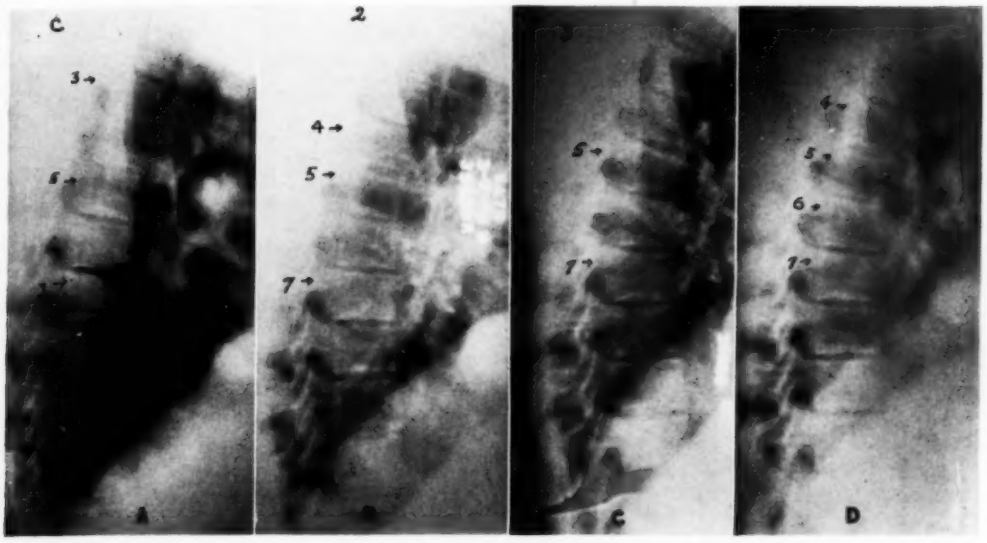

Fig. 2. Inefficacy of curare when administered after the first electric-shock fractures have already appeared: A–D. Films made prior to administration of curare. See also Figs. 2E and F.
A. Film taken prior to electric-shock therapy. Normal spine.
B. Film taken after the second electric-shock treatment showing the superior end-plate concavity or impression of T-5.
C. After the third electric-shock treatment—further superior end-plate impression of T-5.
D. After the fifth electric-shock treatment—anterior compression as well as superior end-plate impression of T-4 and T-5, and beginning superior end-plate concavity of T-6.

sis in 15 cases, or 10 per cent. Thus, superior end-plate impression was the predominant finding in 44 per cent of the cases; anterior compression occurred alone in 41 per cent but in combination with end-plate impression in an additional 13 per cent. Outright fragmentation was not noted.

Miscellaneous Complications From Shock Treatment Other Than Spinal Fractures: One death occurred after the seventh electric-shock treatment and was thought to be related to curare administration. One death several weeks after the completion of the shock series was attributed clinically to "coronary thrombosis." No autopsy was obtained.

There were two cases of femoral fracture: bilateral intertrochanteric fractures in one instance and a fracture of the neck of the left femur in the other. Interestingly enough, in this latter case the femur had been previously amputated in the lower third of the thigh. To our knowledge, these are the first hip fractures reported following *electric-shock convulsive seizures*, though the complication has been described in association with metrazol convulsion therapy (14). These patients with hip fracture also sustained vertebral body injuries.

Relationship of Pain to Fracture: The evaluation of pain complaints is very difficult in this group and, since so many patients are incompetent, is not reliable. Only 13 patients complained of back pain sufficient to warrant its notation upon the chart, without direct questioning. Of these, 8 had fractures and 5 did not. The incidence of back pain, objectively noted, in relation to shock fracture may be considered negligible in our series. It should be emphasized, however, that no attempt was made to elicit a history of pain or complaint referable to the back. If this were done, very likely the findings would be different.

Efficacy of Shock Fracture with Regard to Immediate Clinical Improvement: It is interesting to include in this series the notations regarding clinical improvement

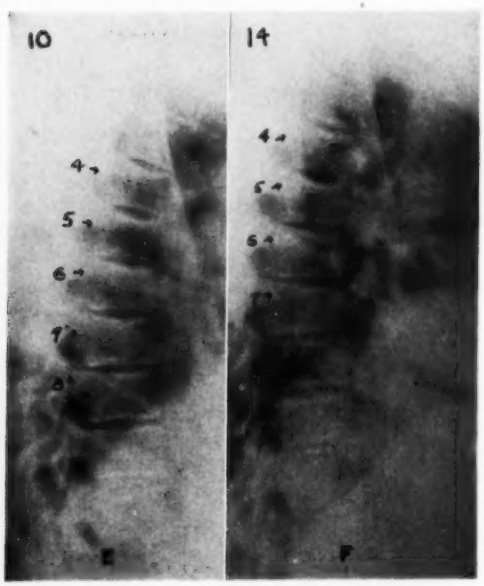

Fig. 2. E. and F. Films made after the administration of curare in case shown in Fig. 2A–D.

E. After the ninth electric-shock treatment. Following the sixth electric-shock convulsion 2 c.c. curare (20 mg. per c.c.) was administered prior to each treatment. There is a slight kyphosis (2 degrees) and slight progression of the fractures of T-4, T-5, and T-6, with end-plate impression appearing in T-7 and T-8, despite the administration of curare.

F. After the fourteenth electric-shock treatment (4 c.c. curare prior to convulsion), there are seen increase in the anterior compressions, superior end-plate impressions, and sclerosis of the end-plates despite the continued use of curare prior to each electric-shock treatment. This may be due to the fact that the vertebral injuries had already occurred prior to the first administration of curare, but became radiographically manifest only as the treatment series progressed. This is substantiated by the fact that most of the spines which ultimately demonstrate fracture do so within the first five electric-shock convulsions.

following shock therapy, though no attempt has been made at this time to evaluate this factor beyond the initial phase. In 208 of the 212 cases, our records are complete in this respect. Fifty-eight patients (28 per cent) had a good immediate result; 15 (7 per cent) showed moderate clinical improvement and 55 (26 per cent) showed slight improvement (Table IV).

As defined by Dr. C. E. Harkey (Acting Chief, Continuous Treatment Service, Veterans Administration Hospital, North Little Rock, Arkansas) *good* includes those patients who improved sufficiently to be discharged from the hospital with maximum hospital benefits. The *moderately* improved group includes those who showed enough improvement to be given trial visits at home in the custody of some responsible person and those who improved enough to be given privileges of open wards. Those patients classified as showing *slight* improvement did not improve enough to leave the locked wards, but they did not constitute the behavior problems that they did prior to the administration of electric-shock therapy. Thus, a total of 61 per cent showed some form of clinical improvement following shock therapy, but this 61 per cent included *only 35 per cent listed as good or moderate* (good enough to leave the locked wards). There were 15 additional cases whose improvement was so temporary as not to be included in the previous categories (7 per cent).

TABLE IV: IMMEDIATE CLINICAL EVALUATION OF RESULTS FROM ELECTRIC-SHOCK THERAPY IN 212 CASES

Objective complaint of backache	12 (5.6%)
With fracture	7 (3.3%)
No fracture	5 (2.3%)
Death	1 (0.5%)
Other fracture (other than dorsal spine)	2 (1.0%)
Clinical improvement	
Slight	55 (26.0%)
Moderate	15 (7.0%)
Good	58 (28.0%)
Very temporary	15 (7.0%)
No information available	4 (2.0%)

The late results are not covered in this tabulation.

CONCLUSIONS

In a study of the dorsal spines of 212 male patients to whom electric shock was administered in treatment of various mental states, the incidence of vertebral body injury was 35.4 per cent, with a total of 192 vertebral bodies affected, or 2.56 vertebrae per patient for those patients in whom fractures occurred. In 150 patients, a control film was obtained and films after each shock treatment for the first five treatments, and, thereafter, after every five treatments. The usual treatment course consisted of approximately twenty shock treatments. Vertebral body injuries occurred in two-thirds of the cases in the first three treatments, and in four-

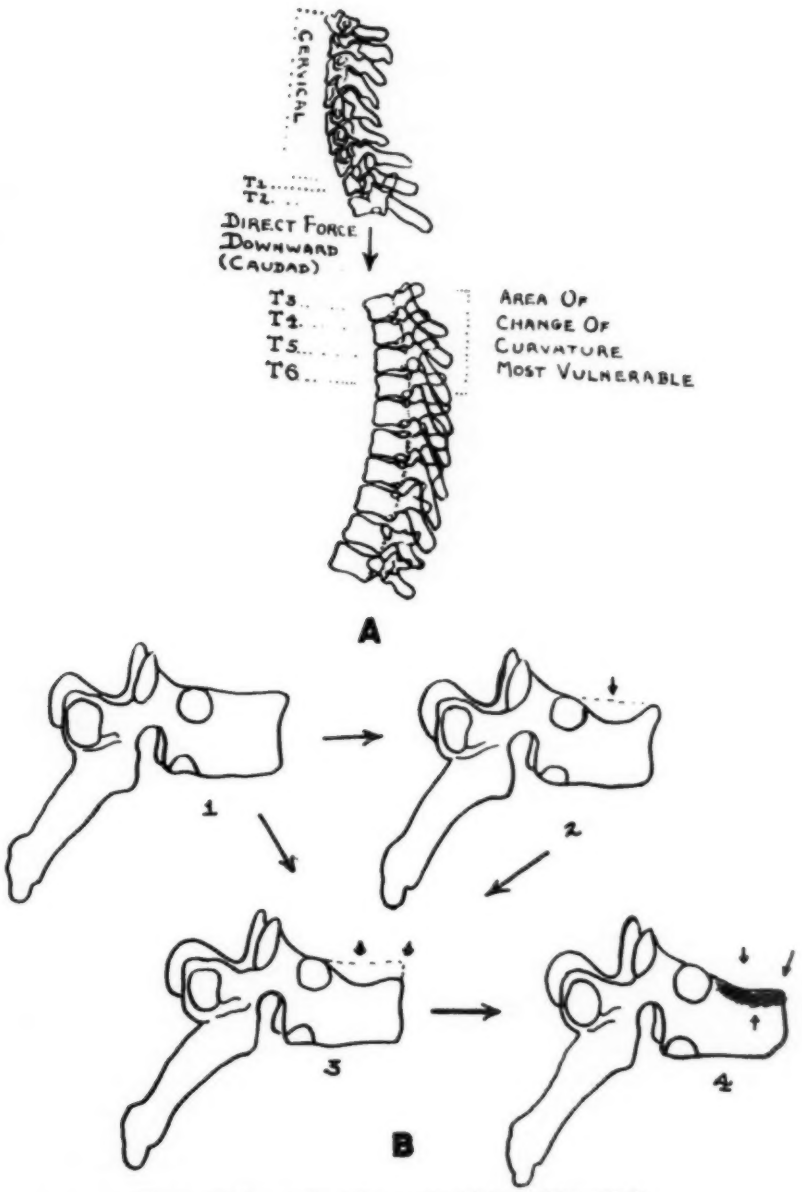

Fig. 3. Pathogenesis of the vertebral injuries (theoretical).

A. The cervical spine and skull are pulled caudad by the longer upper back muscles, and these structures deliver a "hammer-blow" on the superior end-plates of the upper dorsal vertebrae which first curve away from the cervical spine. This gives rise to the *superior end-plate impression*.

B. The flexors of the spine (being more powerful than the extensors) cause, or superimpose, the element of *anterior compression*.

Sclerosis of the fractured element occurs as a result of (1) condensation of fractured bone elements; (2) healing with callus formation.

fifths of the cases within the first five treatments.

The third, fourth, and fifth dorsal vertebrae were predominantly affected. These fractures tend, for the most part, to occur slightly higher in the dorsal spine than metrazol fractures.

In reconstructing the development of these fractures, it is our belief that there is probably first an impression of the intervertebral disk into the superior end-plate of the vertebral body, giving this surface a concave appearance. The superior end-plate, centrally, is thus the first part of the body to give way (see Fig. 3). This is understandable since this is spongy bone and not dense like the outer shell. Subsequent or coincident with this, there is an anterior compression of the vertebral body, with a discontinuity of bony trabeculae in the outer denser zone of bone. Reparative processes then set in, and the zone of fracture in the superior end-plate assumes a sclerotic appearance, with ultimate healing occurring in this manner.

To explain the indentation of the *superior* end-plates of the vertebrae located at the upper dorsal curvature, one may assume that with the electric shock the entire spine cephalad to this level delivers a "hammer-blow" to the superior end-plates in this vulnerable position. This "hammer-blow" is delivered by contraction of the upper dorsal muscles attached to the occiput of the skull and cervical spine (*longus colli, longus capitis, semispinalis capitis, semispinalis cervicis, longissimus capitis, longissimus cervicis, splenius cervicis, splenius capitis*). Subsequently—or simultaneously—the smaller but powerful *flexor spini* muscles superimpose the element of anterior compression.

The injury is, therefore, not only a "flexor" injury, but also (perhaps primarily) a direct cephalo-caudad injury to the superior end-plates in the most vulnerable positions and subjects. This phenomenon is most important and accounts to some extent for the high incidence of vertebral fractures despite the specially constructed hyperextension table.

Since the maximum normal dorsal spine curvature occurs in the uppermost portion of the dorsal spine—the part most frequently affected by these fractures—the resulting deformity is difficult to detect and assay accurately, but some slight deformity probably exists. Back pain from these fractures was negligible during the period of observation.

The only significant complications which occurred were hip fractures, bilaterally in one patient, unilaterally in another patient, and the curare death already mentioned. One patient died several weeks after the course of treatments, probably of coronary thrombosis (no autopsy).

There was a slightly higher incidence of fractures in the 30-to-39-year group than in the other age groups, but the groups under 20 and over 60 years of age were too small for accurate evaluation. The 30-to-39-year group comprised 28.8 per cent of the series, and the incidence of fracture in this group was 45.9 per cent.

There were 80 patients with anterior narrowing of one or more vertebrae demonstrable on the control films. The etiology of this anterior narrowness is not indicated. It appears to be of significance even if we cannot assume any definite relationship to previous shock, history of injury, or compression fracture. Thirty-eight (47.5 per cent) of the 80 patients with anterior narrowness of the dorsal vertebral body suffered fractures following electric-shock convulsions. This comprises just over one-half of the total of 75 fracture cases. The incidence of fractured vertebrae in those cases without anteriorly narrowed vertebrae prior to electric-shock therapy was 28 per cent. However, the vertebrae which were seen to be narrowed on the control films were usually not themselves affected. Thus, this anterior narrowness, whatever its cause (except osteochondrosis, which must be considered separately) would appear to indicate an underlying defect in vertebral structure which predisposes to electric-shock convulsion fracture.

Patients who had had previous shock

convulsive therapy, and whose control films showed anterior narrowness of one or more vertebrae, proved slightly less likely to suffer dorsal spine fractures from the present series of electric-shock convulsions than those who had not had such previous therapy. If they had had previous shock therapy without any vertebral narrowness detectable on the control films, they were much less prone to sustain shock fractures from the present series.

Osteochondrosis, usually remote in the age groups studied, was indicated by any evidence of previous degenerative changes in the secondary centers of ossification of the vertebral bodies (waviness of superior and inferior end-plates with anterior compressions, step-like defect of end-plates, kyphosis). Osteochondrosis was very infrequently associated with vertebral body injury following electric-shock convulsive therapy, despite the kyphotic deformity. Only 11.8 per cent of 34 patients suffered fractures, a significant difference from the over-all incidence of 35.4 per cent and the 40 per cent incidence in those cases without osteochondrosis.

The other factors studied (race, deforming spondylosis, kyphosis, Schmorl's nodes, physician who administered the shock, patient's weight) appeared not to predispose to shock fracture.

Although the number of patients to whom curare was administered from the very start was small, the lower incidence of fracture (19.5 per cent) in this group is significant. Curare did not appear to be of value in arresting the progress of a fracture or preventing the appearance of new fractures once the treatment course had begun and the first evidence of injury to the spine had been already discovered. Since the use of the drug is not without its own risk, it is possible that it should be limited to selected cases, at least until a given therapy team can demonstrate that it can be employed without danger. The patients to be selected for its use from our series would be those 30 to 39 years of age who show any evidence of an anteriorly narrowed vertebral body on the control film (apart from osteochondrosis), and possibly any evidence of scoliosis (although this cannot be said definitely to be a predisposing factor since the number of cases studied with this deformity was so small). Prostigmine should always be on hand for immediate intravenous use if respiratory arrest should occur, and apparently respiratory arrest can be effectively overcome in this manner.

It is probable that the incidence of electric-shock convulsive fractures and metrazol fractures is approximately the same (Easton and Sommers, 1944, reported 37.2 per cent metrazol fractures in male patients). In either case it is a significant figure. While it should not prevent the use of shock therapy, further study is indicated in means and methods of prevention of this complication. Placing the patient in hyperextension during the treatments probably helps but is not in itself the final answer, nor is careful mechanical restraint sufficient, since proper mechanical restraint of all the muscles involved is virtually impossible. Special drug medication which relaxes the muscles or prevents their stimulation (as curare) seems to offer the greatest hope for fracture prevention.

No attempt was made in this study to evaluate electric-shock treatments on a long-term basis, but the immediate results indicated good or moderate improvement sufficient to give the patient a trial visit at home or freedom from a locked ward in one-third of the cases and slight improvement in an additional one-third.

It is difficult for us to evaluate the lower incidence of electric-shock fractures reported by Huddleson and Gordon (6.3 per cent) (5), Worthing and Kalinowsky (10 per cent) (3), and Smith, *et al.* (12). Perhaps the explanation lies in the definition of "vertebral body fracture," or in radiographic technic. Radiographic technic must be particularly good to disclose fractures of the uppermost dorsal spine (around the third and fourth dorsal vertebrae). Injuries of the second dorsal are especially difficult to demonstrate. Usually, demonstration of the first dorsal

vertebra requires special views, which were obtained only where indicated.

Our definition of "vertebral body fracture" refers to an alteration in the appearance of this body as compared with the "control" film. A superior end-plate impression would be the least manifestation ordinarily observed.

Certainly, it is hard for us to evaluate some of the abnormalities listed in the series of Huddleson and Gordon (decreased density of vertebral disks; haziness of intervertebral spaces; miscellaneous), and we find their reported results difficult to interpret.

We found it impossible to evaluate osteoporosis properly and accurately. The overlying lung shadows would make any such attempt of little value, unless a tendency toward "fish" vertebrae, or osteoporotic changes in other bones of the body could assist one in arriving at some conclusion in this respect. Therefore, we cannot completely understand the frequent association of osteoporosis with metrazol fractures noted by Easton and Sommers.

Perhaps, anterior narrowness noted on our control films has some relationship to an underlying osteoporosis or similar abnormality, but we find it impossible to draw any such conclusions.

SUMMARY

1. The dorsal spines of 212 (out of 213) consecutive patients to whom electric-shock convulsive therapy was administered were studied before, during, and after such treatment.

2. The incidence of vertebral body injury was 35.4 per cent, with an average of 2.56 vertebrae involved per patient for those in whom fractures occurred. Since all the patients were males, this figure agrees with the incidence of metrazol convulsive spine fractures reported in the most comprehensive study published (Easton and Sommers), but is considerably higher than other published statistics for electric-shock convulsive therapy.

3. In almost two-thirds of the cases, the vertebral body injuries occurred in the first three treatments, and in four-fifths of the cases within the first five treatments.

4. The third, fourth, and fifth dorsal vertebrae were predominantly affected.

5. The earliest appearances, development, and progression of these fractures were studied.

6. The only other fractures observed were fractures of the hip, bilateral in one patient, and unilateral in another.

7. The age group 30 to 39 years seemed more highly predisposed to fracture than other age groups between 20 and 60 years.

8. There is a high correlation between anterior narrowness of any vertebral bodies on the control films (apart from osteochondrosis) and the subsequent occurrence of vertebral fracture, although very few of the narrowed vertebrae were themselves fractured.

9. Patients who had previous convulsive shock therapy and who had no anterior narrowing of the vertebrae on the control film were particularly resistant to shock fracture.

10. Osteochondrosis seemed to give a patient's spine some resistance to electric-shock fracture, and the incidence of fracture in such cases was low.

11. Other factors studied such as race, deforming spondylosis, kyphosis, Schmorl's nodes, and the physician who administered the shock, appeared to have no relation to electric-shock convulsive fractures.

12. Curare, when administered from the very start, helped to reduce the incidence of fractures appreciably. When administered after fracture had made its appearance, it was of no value in preventing progression or the appearance of new fractures.

13. There was sufficient immediate improvement in the condition of approximately one-third of the patients following electric-shock therapy to be classified as good or moderate; one-third improved very slightly; and in the remaining one-third, improvement was not present or too temporary for consideration. A late evaluation of results is not as yet available.

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SUMARIO

Fracturas de la Espina Dorsal Consecutivas a la Electro-Convulso-Terapia

En 212 (de 213) enfermos consecutivos a quienes se administró la electro-convulsoterapia estudióse la espina dorsal antes del tratamiento, durante el mismo y después. La incidencia de lesiones de los cuerpos vertebrales representó 35.4 por ciento, promediando las vértebras afectadas 2.56 por enfermo en los que experimentaron fracturas.

En casi dos terceras partes de los casos, las lesiones vertebrales sobrevinieron en los primeros tres tratamientos, y en cuatro quintas partes de los casos en los primeros cinco. Las tercera, cuarta y quinta vértebras dorsales fueron las afectadas predominantemente. Las únicas otras fracturas observadas fueron de la cadera: bilateral en un caso y unilateral en otro.

El grupo de 30 a 39 años de edad pareció ser más predispuesto a fracturas que otros grupos etarios entre 20 y 60 anos.

Descubrióse alta correlación entre la estenosis anterior (aparte de osteocondrosis) de cualquier cuerpo vertebral en las radiografías de comprobación y la ocurrencia subsiguiente de fractura vertebral, aunque poquísimas de las mismas vértebras estrechadas se fracturaron. Los enfermos que habían recibido antes la convulsoterapia y que no mostraban estrechez anterior de las vértebras en la radiografía de comprobación fueron en particular resistentes a las fracturas debidas al choque terapéutico.

La osteocondrosis pareció impartir cierta resistencia a las fracturas por choque eléctrico en el raquis, y en los casos de la misma la incidencia de fracturas fué baja. Otros factores estudiados, tales como raza, espondilosis deformante, cifosis, nódulos de Schmorl, y médico que aplicó el choque, no guardaron aparentemente relación con las fracturas producidas por el choque eléctrico.

El curare, administrado desde el mismo principio, ayudó a rebajar apreciablemente la incidencia de fracturas. Administrado después de haber aparecido la fractura, resultó inútil para impedir el avance de las fracturas o la aparición de otras nuevas.

Aunque no se trata de justipreciar la eficacia de la electro-convulso-terapia a base larga, los resultados inmediatos mostraron aproximadamente en la tercera parte de los enfermos mejoría suficiente para clasificarla como buena o moderada. Otra tercera parte mejoró ligeramente, y en la tercera parte restante, no hubo mejoría o fué demasiado pasajera para prestarle atención.

Downward Displacement of the Gastric Cardia[1]

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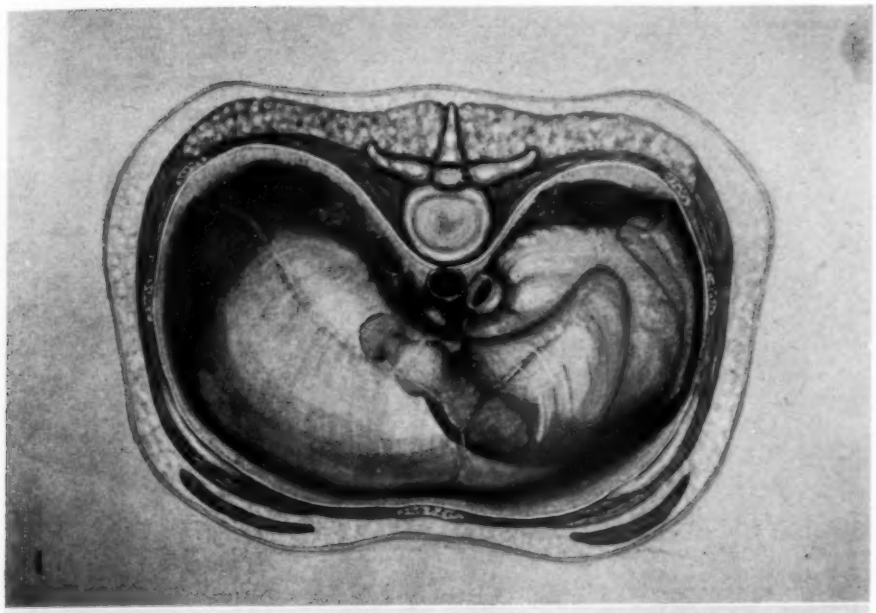
IN THE SEARCH for abnormalities of the esophagus, stomach, and duodenum, reliable performance on the part of the examiner calls for his critical attention to a considerable number of anatomical and physiological details before, during, and after the ingestion of opaque material. Only with the accumulation of experience is it possible for the radiologist to carry away from the fluoroscopic examination of his patients a sufficiently detailed impression of the rapidly changing appearances which he has observed to enable him to venture a diagnosis. To fail to observe closely the advancing margin of the opaque column at the instant when it first encounters successive portions of the upper gastro-intestinal tract is to court errors of omission. Many lesions of importance are seen to the best advantage, if at all, before the lumen is fully distended with opaque material. It is unlikely that the most advantageous filming will be carried out unless the fluoroscopist has first had his curiosity aroused by some vagary of filling observed during the course of barium ingestion.

Because the efficacy of x-ray methods in the matter of detecting gastro-intestinal lesions depends to such a large degree upon the recognition of deviations from the normal, and because normal status of the structures in question is such a variable quantity as encountered in a succession of individual patients, it is important that any unusual finding, morphologic or functional, be explored with thoroughness.

Over the years we have learned by experience to look, in every patient under examination, for hypopharyngeal diverticulum, traction diverticulum of the esophagus, hiatus hernia, lesser curvature gastric ulcer craters, pyloric obstruction, deformities of the first portion of the duodenum which are characteristic of ulcer, as well as filling defects of all types which are known to be commonly encountered signs of neoplastic lesions. These and a great number of additional roadside signs of disease must be in the mind of the examiner throughout his fluoroscopic observation of every patient, regardless of the symptoms which brought that patient to examination. Whenever an examiner permits himself to anticipate what he is going to find in advance of the actual examination, he runs the risk of neglecting to devote sufficient attention to all portions of the upper gastro-intestinal tract. It is particularly easy to do this when abnormality of one sort or another is encountered before the barium reaches the stomach. Fortunately, mistakes of this sort can often be corrected on the basis of careful examination of subsequently exposed films, although this is by no means always the case.

The relationship of the superior wall of the cardiac portion of the stomach to the overlying left diaphragm is sufficiently constant under normal conditions to serve as a landmark of considerable reliability. If, in the course of fluoroscopic and radiographic examinations of the upper gastro-intestinal tract, this normal relationship is found to be disturbed, that observation of itself can be of great diagnostic value. Normally, the left half of the diaphragm comes in direct contact with the outer surface of the stomach throughout the greater portion of the superior wall of its cardiac portion, as well as the anterolateral and the posteromedial aspects of the organ in its upper half. Anteriorly the lesser lobe of the liver, attached along its posterior margin by the gastrohepatic membrane, is interposed between the gastric cardia

[1] From the Department of Roentgenology, University of Michigan. Presented at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.



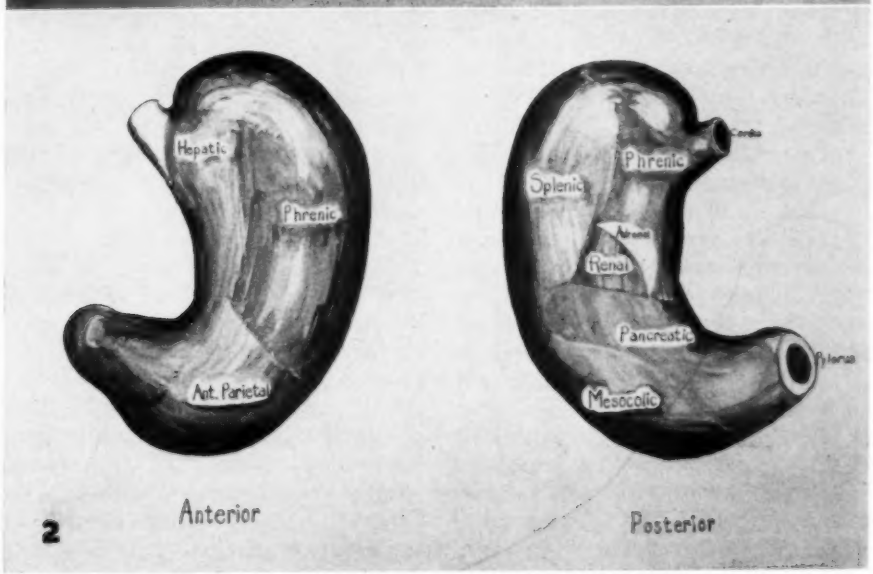


Fig. 1. Schematic drawing of abdominal organs viewed from above with diaphragm removed to show relationship of the stomach to the liver, the left kidney, and the spleen.

Fig. 2 Schematic drawing of the stomach in anterior and posterior views, showing areas of contact with other abdominal structures.

and left diaphragm, and posterolaterally the spleen wedges between the diaphragm and the stomach (Figs. 1 and 2). As the result of these anatomical relationships, the gastric cardia, whether inflated with gas or filled with opaque material, can be identified fluoroscopically or in films, lying for the most part closely applied to the under surface of the dome of the left diaphragm. These relationships do not

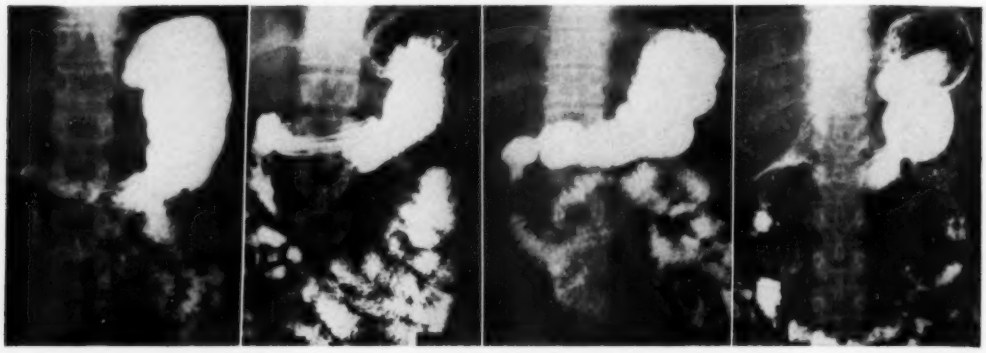


Fig. 3. Roentgenograms of the stomachs of four individuals showing normal relationships between cardiac portion and the overlying diaphragm.

change significantly with changes in position of the body which are commonly employed in this type of examination (Fig. 3).

When any material degree of separation between the diaphragmatic contour and the lumen of the gastric cardia can be demonstrated, such downward displacement of the gastric cardia can be explained in one of several ways. It may represent unusual enlargement of the lesser lobe of the liver, enlargement and upward and medial encroachment by the spleen, or both of these situations simultaneously. It is well to remember that generalized enlargement of the liver is usually associated with sufficient increase in the size of the lesser lobe to produce this sign. Downward displacement of the gastric cardia may mean the interposition of fluid between otherwise normally disposed upper abdominal viscera and the diaphragm. Such fluid, of course, may be blood, escaped gastric contents, or pus. The same sign of downward displacement of the cardia with respect to the diaphragm may represent great thickening of the gastric wall in this region, with consequent encroachment upon the lumen of the stomach. All of the situations capable of producing this roentgenologic sign may well be of diagnostic value, and the disturbed anatomical relationship is, therefore, fully worthy of attention.

Those situations which fall in the latter category, namely, abnormalities which result in great increase in the thickness of the gastric wall, will be found to be more commonly encountered and in general to offer information of the most serious import. Very rarely one encounters a patient with phlegmonous gastritis which is capable of producing this sign, and occasionally massive varicosities within the gastric wall can be so recognized, but by far the most common cause of the sign is primary gastric carcinoma within the wall of the roof of the stomach, projecting beneath invaded mucosa into the lumen. The careful reexamination of patients showing nothing more definitive than downward displacement of the cardia on initial examination leads in a good many instances to the recognition of primary neoplasms in the cardia which might easily escape notice otherwise. It is well known to all of us that our errors in gastric diagnosis are more commonly those of commission at the lower end of the organ; errors of omission at the proximal pole. Any hint of abnormality involving the cardiac portion of the stomach is worthy of further investigation.

An example of profound displacement of the entire stomach both toward the right and downward was observed in a patient (Mr. A. McC., age 52) with polycythemia vera. In this instance the spleen was of enormous size and was largely responsible for the displacement of the stomach.

Great enlargement of the liver, confirmed by the surgeon at the time of cholecystectomy, is responsible for the degree of downward displacement of the cardia observed in the case of Mrs. A. P., age 55 (Fig. 4).

In the case of Mrs. A. M., age 56, enlargement of the liver and the spleen, coupled with the discovery of tumor cells in the sternal marrow and the circulating blood, led to the search for a primary malignant tumor. Although the roentgenologic sign of downward displacement of the cardia was clearly recognizable in this case, lymphoblastoma, proved on the basis of lymph node biopsy, rather than primary

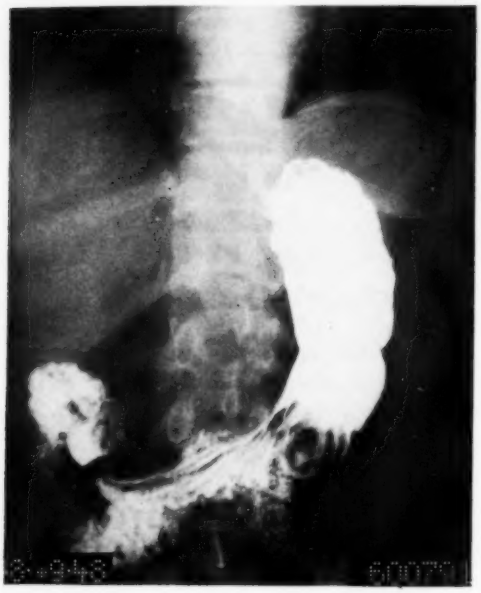


Fig. 4. Downward displacement of the gastric cardia produced by liver enlargement, confirmed at the time of cholecystectomy.

gastric carcinoma was felt to be the explanation. The separation of the stomach from the diaphragm is undoubtedly a function of enlargement of the liver and the spleen.

In the case of Mrs. H. C., age 60, the clinical picture of chronic blood loss led to the search for suspected carcinoma of the right colon, carcinoma of the stomach, or diaphragmatic hernia with mucosal ulceration. Roentgen examination showed unquestioned evidence of massive varicosities in the lower end of the esophagus, and the downward displacement of the stomach, in part produced by enlargement of the lesser lobe of the liver, may well be caused to

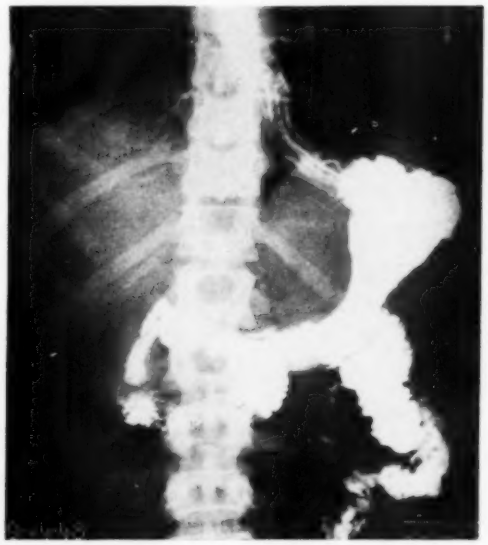


Fig. 5. Downward displacement of the gastric cardia produced by extensive gastric varicosities, surgically proved.

some extent by similar varicosities in the gastric wall itself.

It was not difficult to demonstrate esophageal varices in the case of Mrs. L. C., age 28, who also showed downward displacement of the gastric cardia. Prior to this examination the spleen had been removed as a therapeutic measure and subsequently the patient was subjected to partial esophagogastrectomy, thereby providing conclusive proof of the fact that, in this instance at least, massive varicosities in the wall of the stomach itself were contributing to the displacement of the cardiac lumen (Fig. 5).

Mr. S. M., age 64, presented ample evidence, both clinical and radiologic, to warrant a diagnosis of subphrenic abscess on the left. On x-ray examination it was also observed that ingested opaque material left the stomach along the greater curvature in the upper half to enter the abscess area, thus suggesting that rupture of the stomach, perhaps through a pre-existing neoplastic lesion, had occurred. In this instance, downward displacement of the cardia might have either of two explanations—purulent fluid occupying the space

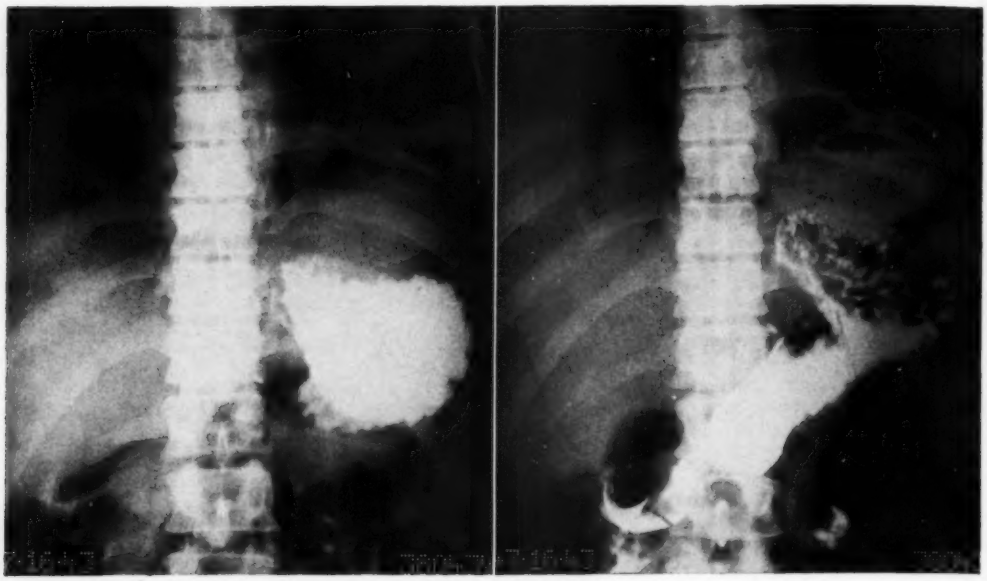


Fig. 6. Downward displacement of the gastric cardia produced by subphrenic abscess on the left.

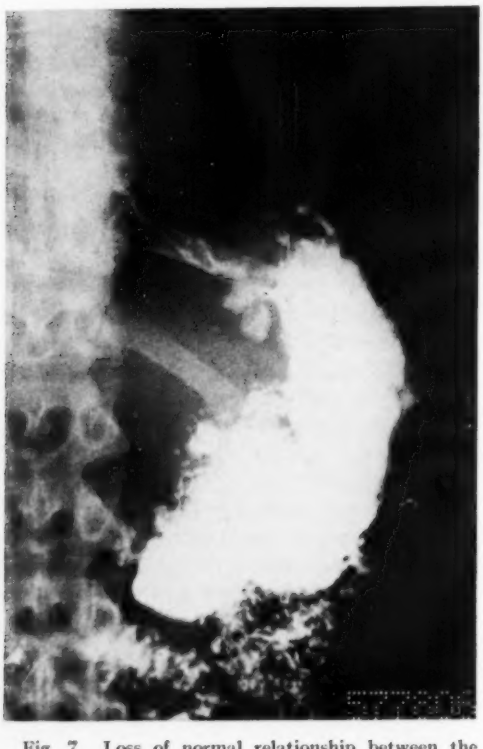


Fig. 7. Loss of normal relationship between the diaphragm and gastric lumen resulting from primary adenocarcinoma of the gastric cardia.

between the gastric cardia and the diaphragm, or massive neoplastic infiltration of the upper wall of the gastric cardia. At the time of operation, the latter seemed to be the true explanation, since an extensive mass involving the cardia of the stomach was firmly adherent to the diaphragm with no indication that the abscess cavity penetrated into that zone.

In the case of Mr. O. C., age 41, the victim of multiple, successive episodes of venous thrombosis associated with Buerger's disease, for which the right leg was amputated, there developed clinical and roentgen signs of subphrenic abscess on the left which were clearly recognizable as such and which incidentally produced characteristic downward displacement of the cardia (Fig. 6).

Mr. W. H., age 52, showed a characteristic extensive, ragged filling defect of the lower third of the esophagus, with obvious involvement of the subdiaphragmatic portion of the tube, as well as separation of the gastric cardia from the diaphragm. Surgical exploration showed that the left lung was adherent to the diaphragm, through which the examiner could feel a hard, fixed

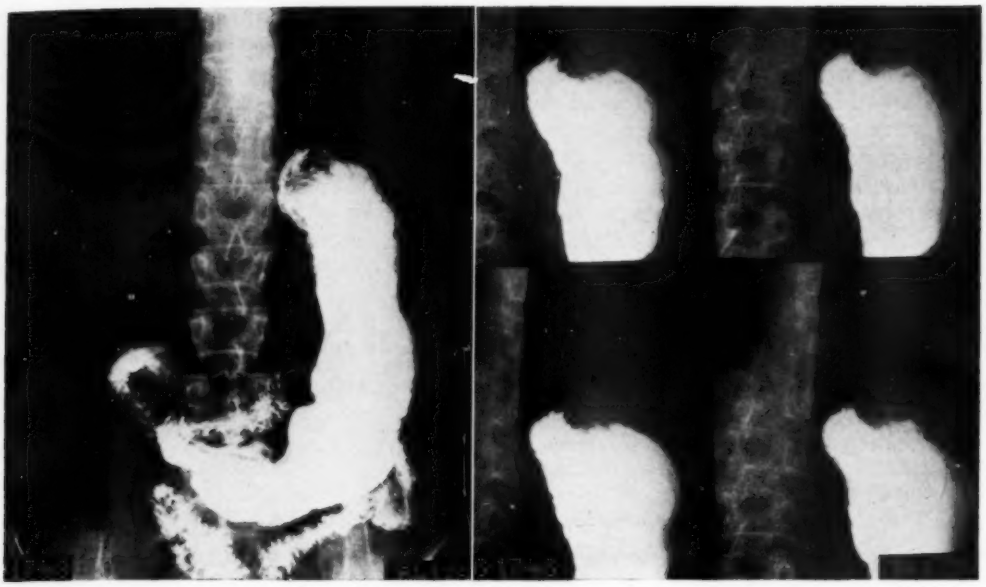


Fig. 8. Downward displacement produced by the spleen in a profoundly emaciated patient.

mass beneath. Tissue examined microscopically showed medullary squamous-cell carcinoma, proving that the primary growth had been in the esophagus and that the neoplastic mass beneath the diaphragm represented extension of the lesion.

The reverse of the previous situation is seen in the case of Mr. W. B., age 48, who was found at transthoracic operation to have an adenocarcinoma of the stomach which had extended upward into the diaphragm. Again, downward displacement of the gastric lumen is easily demonstrable (Fig. 7).

Mr. W. R., age 58, represented one of those relatively uncommon instances in which a neoplasm at the cardiac end of the stomach can be seen silhouetted against the transparent air bubble in the cardia. Once such a tumor has developed to considerable size, it may appear to separate the stomach from the overlying diaphragm. Actually encroachment upon the lumen occurs as the thickness of the gastric wall increases.

In the case of Mrs. M. D., age 36, the one consistent finding was abnormally wide separation of diaphragm and cardia. In addition to this, the extreme upper portion of the cardia was always irregular, though not constantly and rigidly irregular on various examinations. It is our feeling that this patient and others with similar findings should be looked upon as cancer suspects until all available means of examination have been exhausted to disprove that suspicion. This patient's clinical complaints and symptoms have not as yet resulted in surgical exploration.

In the case of Mrs. M. M., age 68, our insistent suspicion of a significant lesion involving the gastric cardia on the basis of the sign we have been discussing was adequately disproved at the time of laparotomy for the relief of common duct stricture following cholecystectomy. Our surgical friends were unable to confirm the presence of any lesion of this sort and felt that we must have been misled by interposition of the lesser lobe of the liver.

Asked to search for gastro-intestinal neoplasm as a possible explanation for anemia and weakness in the case of Mrs. B. S., age 68, we felt that we had discovered a significant abnormality in the form of irregularity of the contour of the gastric cardia and

abnormal separation of this portion of the stomach from the diaphragm. In this instance we were guilty of sending the patient to the operating table needlessly. The surgeons found no abnormality in the left upper quadrant and offered the explanation that, because of the patient's great emaciation (she weighed only 86 pounds), the spleen, which was moderately enlarged, had figured more prominently than usual in separating the stomach from the diaphragm (Fig. 8).

Though it cannot be considered an infallible sign of significant left upper quadrant disease, visible downward displacement of the gastric cardia away from the overlying left diaphragm is a very helpful finding which often leads to the clarification of obscure situations of considerable clinical interest and importance. Upon finding it, roentgenologists will do well to worry sufficiently to bring about careful and searching re-examination of the cardiac end of the stomach and the structures which lie in close proximity to it.

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SUMARIO

Desplazamiento Descendente del Cardias

Aunque no puede considerarse como signo infalible de afección importante del hipocondrio izquierdo, el prolapso visible del cardias y su alejamiento de la porción izquierda del sobreyacente diafragma constituye un hallazgo útil, que a menudo permite esclarecer situaciones oscuras de considerable interés clínico. Al observarlo, los roentgenólogos harán bien en instituir un cuidadoso y prolijo re-examen del extremo esofágico del estómago y de los tejidos que le quedan más próximos.

Dicho signo puede representar hipertrofia inusitada del lóbulo menor del hígado, hipertrofia y penetración ascendente y media por el bazo, interposición de líquido entre el diafragma y vísceras de la porción superior del abdomen por lo demás normalmente situadas o espesamiento de la pared gástrica con la consiguiente intrusión en la luz del estómago. El aumento en el espesor de la pared gástrica es en general de la mayor seriedad, por deberse en la mayor parte de los casos a carcinoma dentro del techo del estómago que proyecta a la luz por debajo de la mucosa invadida.

DISCUSSION

Calvin L. Stewart, M.D. (San Diego, Calif.): I wish to opine that downward displacement of the stomach is a darned good sign. It is a privilege and an honor to have an opportunity to discuss this very excellent paper. Dr. Hodges is to be complimented for his timely essay. He has been so thorough in his discussion that there is little or nothing left to add.

He has stressed the importance of keeping the searching eye on the "fluoroscopic ball" and the necessity of accumulated experience to enable the radiologist to walk away from the fluoroscopic screen with a final impression as to the findings. While we are accumulating this experience, we would do well to make a routine of first allowing the patient to swallow one ounce of barium mixture from a one-ounce medicine glass, observing the barium carefully before more is swallowed. The second must is to obtain one or more films of the gastric cardia with the patient in the erect position. This might be a good plan for all of us to use in order to follow accurately the progress of increasing downward displacement shown by successive examinations.

Dr. Hodges has pointed out that determination as to whether the gastric cardia is actually displaced downward is not easy; therefore, I suppose that we are to be forgiven for our errors. We do not have a reference point of bone, as in the case of the retropharyngeal space.

The essayist has enumerated the various causes of downward displacement of the gastric cardia. I would like to ask him if excess epicardial fat and a large heart have given him cause for worry in this respect.

We are grateful to Dr. Hodges for his words of

wisdom in the application of this valuable sign. I am sure that in the future we will all watch more carefully for it.

Frederic E. Templeton, M.D. (Seattle, Wash.): I can see one major difficulty in determining whether the downward displacement of the stomach is abnormal. If one looks at a lateral chest film it is perfectly obvious that the anterior portion of the diaphragm is higher than the posterior portion. The stomach lies more posteriorly than anteriorly. The straight projection shows seemingly downward displacement of the stomach, and as one moves the tube down toward the feet, the stomach tends to move down with it, and this downward displacement becomes regular. Then, as one moves the tube toward the head, the downward displacement will disappear. I would like to hear Dr. Hodges make some comment on that.

Dr. Hodges (*closing*): Regarding the effect of cardiac enlargement and the presence of pleuropericardial deposits, it has been our experience that these situations are easily recognizable in preliminary examinations and that they have not been bothersome in determining the relationship of the gastric cardia to the overlying diaphragm.

Dr. Templeton's comments regarding the downward and posterior slope of the diaphragm from its high anterior attachment and the relatively posterior position of the gastric cardia are entirely pertinent. Since the standard filming procedure in our department calls for postero-anterior projection with the patient prone on the film, divergence of the x-ray beam corresponds in a measure to the slope of the diaphragm and probably results in the projection of the gastric cardia and diaphragm in the relationship which I have tried to show is commonly observed. Certainly it is true that in checking a very considerable number of films exposed in this fashion, the relationship described as normal is very constant, and separation of the two structures represents an unusual finding which warrants strong suspicion of significant abnormality.

Roentgenographic Estimation of the Mineral Content of Bone[1]

GEORGE C. HENNY, M.D.

Philadelphia, Penna.

IT IS WELL KNOWN that adult bone is not merely an inert structural material but is a living tissue with a mineral content which fluctuates under the influence of endocrine and enzyme activity. Hevesy (1) showed, by the use of radiophosphorus, that there is active metabolism in bone. He found, for example, that within fifty days 29 per cent of the mineral constituents were renewed in the femoral and the tibial epiphyses of rabbits. In pregnancy there may be a transfer of calcium and phosphorus from the bones and teeth of the mother to the tissues of her child. Over 60 per cent of the skeletal calcium of the newborn child is laid down during the last two months of prenatal life. The trabeculae of the bone constitute a calcium store which is available for maintenance of the calcium requirements of other tissues when the ingested supply is insufficient. The ratio of calcium to phosphorus remains essentially constant. The mineral content of bone may fluctuate even in health, but particularly in certain cases of endocrine imbalance, such as in hyperparathyroidism. It is of considerable interest, therefore, to be able to estimate, to a fair degree of accuracy, this mineral content.

The problem divides itself into two categories: (*a*) the absolute determination of the mineral content, so as to make possible a comparison of the value with corresponding normal values, and (*b*) the comparison of successive determinations of the same patient, so that the progress of the bone changes may be followed.

The area of bone best suited for an absolute determination of the mineral content is probably the central portion of the femur (Fig. 1), because here we have a thickness of cortex which can be measured in millimeters. The mineral content per millimeter of cortex gives a measure of the concentration of calcium and phosphorus in the bone. The cortex is so dense, however, that a change in mineral content, as a result of therapy for example, may not show up as soon as it will in the cancellous bone. Therefore, for comparisons of successive determinations, an area of can-

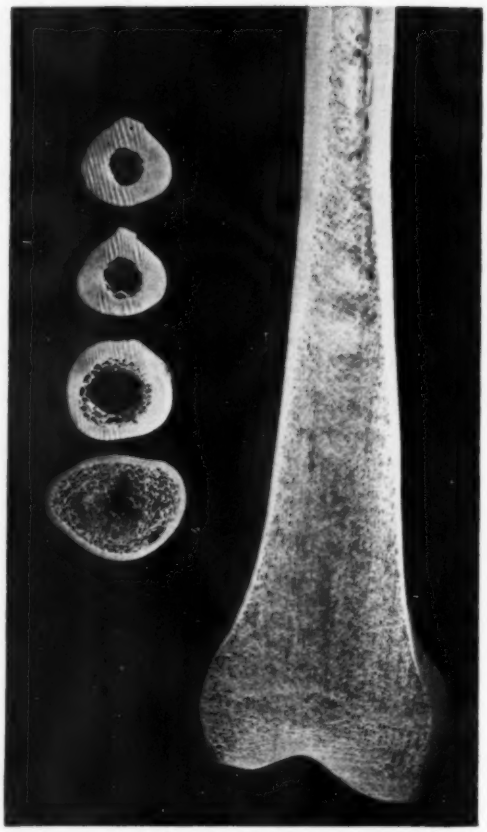

Fig. 1. Longitudinal section of a femur with some cross sections cut at different levels. The cancellous or spongy bone is well shown, especially in the inferior end, where the cortex is thin. The linea aspera, on the posterior surface of the femur, projects as an irregular ridge, as shown in the cross sections.

[1] From Temple University Medical School, Philadelphia, Penna. Read before the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.

cellous bone may be chosen, as this will be more quickly sensitive to changes in calcium metabolism.

Other bones might have been measured. Bywaters (2), for example, used the heads of the metacarpals. This is a good area for comparative purposes, between successive examinations, as the soft tissue here is quite thin. The bone, however, is somewhat cancellous, and thus it is difficult to estimate the absolute amount that has been traversed by the x-ray in the area being measured. It is desirable to use for measurement a bone which has a fairly smooth surface and an area large enough to be measured with a densitometer. The size of the area depends upon the type of densitometer employed. We use an area 4 mm. in diameter (3). The calcaneus might be used, as it offers a fairly flat area, and the soft tissue there is quite thin.

The femur offers certain advantages for measurements but presents the disadvantage of being surrounded by a large thickness of soft tissue. The advantages are that several smooth and relatively uniform areas can nearly always be found and the thickness of the cortex in the area being measured can be determined. Figure 1 shows a longitudinal section of part of a femur and four cross sections taken at intervals along the bone and arranged in the relative order in which they were cut. The bottom section shows a great deal of cancellous bone with a relatively thin cortex. This area must be used for measurement in cases where rapid changes in calcium content are of interest, as in following the effect of a therapeutic regime. As we move upward, the cancellous bone decreases and the cortex becomes thicker and thicker. Also, the linea aspera becomes prominent and projects as an irregularity. It is for this reason that it is undesirable to use the anteroposterior projection of the femur for measurement of the x-ray absorption. It is readily seen that slight rotation could make a very considerable difference in the amount of bone traversed by the x-ray beam in that projection. Thus successive estimations might appear to show large variations in mineral content which were not actually present. If the lateral projection is used, the bone surfaces are much more regular. By comparing the lateral projection, on which the density determinations are made, with an anteroposterior roentgenogram, the level at which the cortex should be measured is found, and thus the thickness of cortex penetrated by the x-ray at the area measured is determined. The

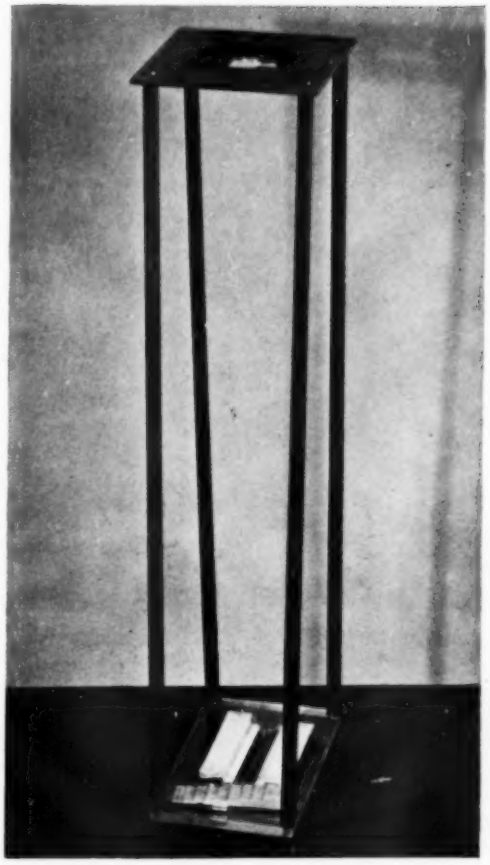

Fig. 2. Apparatus to aid in exposing roentgenograms for estimation of the mineral content of bone. The top plate fits snugly into the cone slot of the roentgenographic tube. The lead diaphragm confines the x-rays to the plexiglas plate below. The protrusion to the right in the diaphragm allows the passage of rays so as to include the knee in the roentgenogram. Below is a plexiglas plate on which are mounted two beef-bone ladders and an aluminum ladder. The aluminum ladder will not be used routinely. The length of the device is made to correlate with the proper distance for the Potter-Bucky diaphragm.

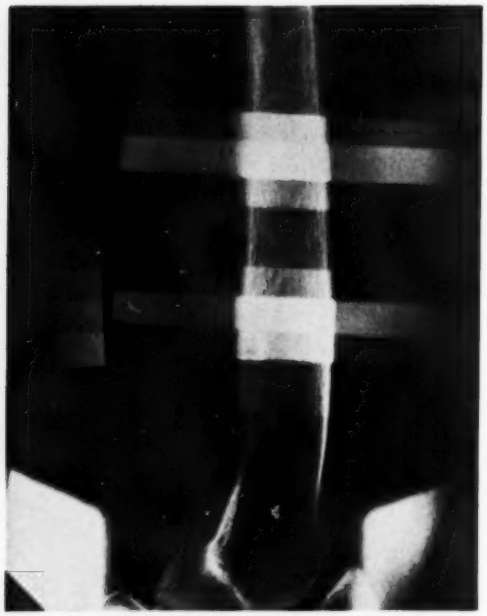

Fig. 3. Roentgenogram of the femur exposed with the apparatus shown in Figure 2. The lateral projection is used. The bone phantom shadows across the femur allow areas near the shaft to be measured and thus more nearly compensate for soft-tissue x-ray absorption. The aluminum ladder is too far from the femur and was used only for cross-checking purposes.

marrow cavity has essentially the same x-ray absorption as the soft tissue.

METHOD

The procedure which is to be described for the roentgenographic estimation of the mineral content of bone is similar in principle to methods previously published (2, 5). It depends upon a comparison between the absorption of x-rays in a bone of the patient and the absorption in a phantom placed close to this bone. The phantom we use is made of thin slabs of beef bone which have been cut on a metal band saw and smoothed off on a sander to uniform thickness. Bone was used because its absorption will run parallel with that of the femur should there be an unintentional variation in kilovoltage between successive roentgenograms. The slabs, fastened together, provide several different known thicknesses of bone. They are placed on a plexiglas sheet (Fig. 2) which is fastened by four aluminum rods to a plate. The latter slips into the cone slot of the roentgenographic tube housing and is thus held firmly in place by the tube stand. A diaphragm, shown above in the illustration, restricts the x-rays to the area being studied. An elongation in the aperture is oriented so as to include the distal end of the femur, which then shows on the film and can be used as a landmark.

The patient, lying on his side, is placed with his flexed leg against the table top and the other leg extended and out of the way. The apparatus fastened to the tube is brought down so that the flat plexiglas surface, parallel with the table top, rests on the medial surface of the thigh and flattens out the soft tissues. The soft-tissue thickness is measured and recorded. The strips of bone should be transverse to the axis of the femur and should extend about equally on either side of it. A Potter-Bucky diaphragm is used to cut out scattered radiation. A fairly heavy x-ray exposure is made so as to produce photographic densities between 0.75 and 2.0 (for our film and processing methods) within the bone areas.

To obtain uniform processing over the surface of the film, it is desirable to develop the film with agitation. This may be done by rotating the film back and forth in the developer, about a vertical axis. Unless this is done, the products of development will diffuse downward in the emulsion and may introduce errors in estimation. The resulting roentgenogram will appear like the one shown in Figure 3. After the lateral roentgenogram is exposed, an anteroposterior view of the same femur is taken. This will be used to determine the thickness of cortex in the area being measured.

The density of two or three areas along the center line of the femur shadow on the lateral roentgenogram may be measured with a densitometer (3).[2] Then areas of

[2] The Eastman Kodak Company has recently made available their Kodak Color Densitometer, Model 1, which may be used. The area of film measured is circular and 1.5 mm. in diameter, so an average of a larger area of the roentgenogram should be obtained to average out irregularities.

the bone phantom on either side of the femur shadow are measured. From the known thickness of the phantom strips and the densities of those areas, a curve, as in Figure 4, may be plotted. If the exposure is made properly, this curve should be smooth and nearly straight. From the densities of the femur areas, the equivalent millimeters of bone phantom may be found. In Figure 4, the density of the femur area was 1.5 and this is seen to correspond to 5.5 mm. of the bone phantom. From the anteroposterior film, the total thickness of cortex at the exact level at which the measurement was made, is obtained. From the two views, knowing the tube-to-film distance, one can make the correction for shadow magnification. Dividing the equivalent millimeters of bone phantom by the thickness of cortex gives the equivalent thickness of one millimeter of femur cortex in terms of the phantom. If the quantitative chemical determination for calcium and phosphorus has been made on the material of the bone phantom, then the mineral content of the femur can be expressed in terms of milligrams of calcium and phosphorus per cubic millimeter of femur cortex. By making studies on patients known to have normal calcium metabolism, normal ranges of calcium values can be established for different age groups. Thus, from the first estimation on a patient, a fair idea may be obtained of the degree of mineralization of his femur.

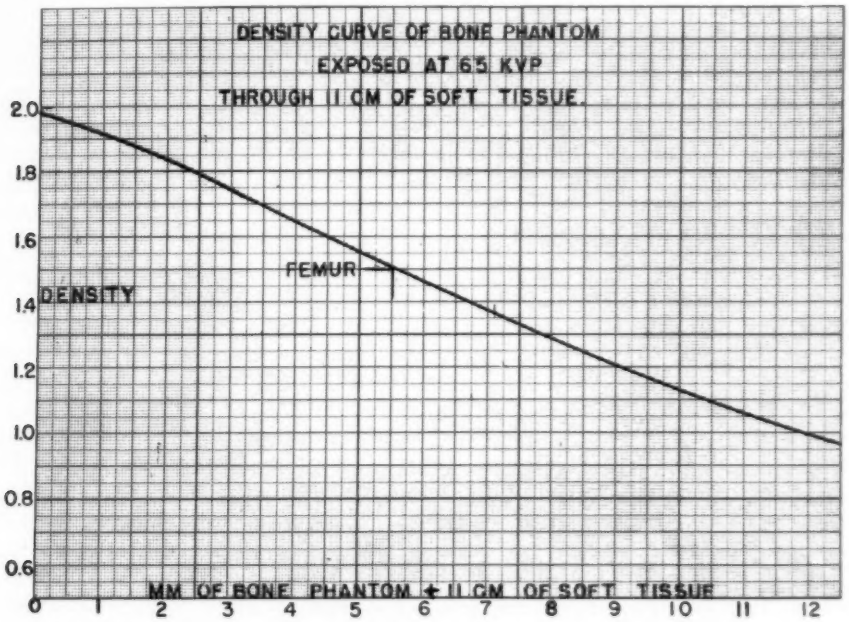

Fig. 4. Curve showing the photographic densities *vs.* the thickness of the bone phantom plus 11 cm. of soft tissue. The equivalent thickness of the femur is indicated.

If evidence of rapid changes in mineral content of the bones is sought, it would be better to study the cancellous portion of a bone, for which the proximal portion of the femur could be used. In this case, the thickness of solid bone traversed by the x-rays cannot be measured, and thus an absolute value of the mineral content per millimeter of bone is not determined. Relative values of the whole bone, from one examination to the next, can be obtained, provided the positioning of the patient is exactly the same each time and the same area of bone is measured. The result is

best expressed in terms of percentage change of the mineral content.

THEORY

The method, as stated above, depends upon a comparison between the absorption of x-rays in a bone of the patient and the absorption in a phantom placed over this bone. The comparison is made *via* the photographic process of the roentgenogram. The theory of x-ray absorption as well as the laws of blackening of the film emulsion should be considered.

The logarithmic absorption of a monochromatic beam of x-rays is expressed mathematically as follows:

$$I = I_0 e^{-\mu T} \tag{1}$$

where

- I = intensity of the transmitted beam
- I_0 = intensity of the beam incident on the absorber
- μ = the linear absorption coefficient of the x-rays in the material of the absorber
- T = thickness of the absorbing material
- e = base of natural logarithms (2.718)

This equation is strictly true in theory only, because the x-rays we use are far from monochromatic and they change in quality as they traverse the material of the absorber. However, the degree by which the practical case deviates from the theory can be judged from the shape of the plotted transmission curve. It is found that this deviation is not so great as to be a limiting factor.

From the equation, the absorption is seen to be a logarithmic function of the absorption coefficient, μ, and the thickness of the absorber, T. If T remains constant, the absorption is a function of μ. The absorption coefficient depends upon the quality (spectral distribution) of the x-rays and upon the atomic constituents of the absorber. So, if we can keep the quality of the x-rays constant from one examination till the next, and all other conditions of exposure the same, the absorption will be a function only of μ.

The absorption coefficient of any tissue depends upon its density and composition. The composition expresses what atoms are present. Since the atoms act individually, it makes no difference how they are combined chemically. The relationship for μ which seems best to fit for the roentgenographic range of x-rays is

$$\mu = k\lambda^3 Z^4 + A \tag{2}$$

where

- μ = linear absorption coefficient
- k = a constant depending upon the absorbing material
- λ = wave length of the x-rays
- Z = atomic number of the absorbing material
- A = a scattering coefficient, being about 0.2 for roentgenographic conditions

The second term of the equation accounts for the photoelectric effect, and the third term the modified and unmodified scattering.

For diagnostic x-rays (long wave lengths) and for soft tissue which contains mostly H, O, and N atoms (low atomic numbers), the scattering coefficient, A, is relatively constant with kilovolts applied to the roentgen tube. But for heavier atoms, such as Ca or P, the photoelectric absorption dominates. In the equation, the wave length (λ) is raised to the third power, so that the kilovoltage used in making the roentgenogram will have a large effect upon the absorption in bone. The atomic number Z, in the equation, is raised to the fourth power, which means that the absorption increases enormously for the heavier elements. This increase is very much more rapid than the increase in physical density. The result is that most of the absorption in bone is due to the mineral content, and a measure of the absorption is in effect a measure of the mineral content. The absorption coefficient of a compound is made up of the sum of the components of each of its elements. The atoms act independently of the chemical combination in which they are found. Thus, if μ_{Ca} is the atomic absorption coefficient of calcium, μ_P that of phosphorus, etc., the absorption coefficient of a pure compound such as $Ca_3(PO_4)_2$ would be

$$\mu_{Ca_3(PO_4)_2} = 3\mu_{Ca} + 2\mu_P + 8\mu_O \quad (3)$$

This represents the sum of *atomic* coefficients; if the linear absorption coefficient (absorption coefficient per unit thickness) is wanted, it is necessary to divide by the density of the compound. This means that, if in one case a given amount of minerals is distributed through 1 mm. thickness of bone (per square centimeter) and in a second case the same minerals are distributed through 2 mm. thickness of bone, in the latter case the linear absorption coefficient will be just half of what it was in the former. That is, the linear absorption coefficient is proportional to the concentration of minerals. In the absorption equation (1) the product μT determines the absorption. Thus, all other factors remaining constant, if the absorption in a patient's femur is found equal to that of thickness T_1 of a bone phantom on the first examination and equal to thickness T_2 on a subsequent examination, then the ratio T_2/T_1 represents the fractional change in the mineral content between the examinations. This is assuming that the ratio of calcium to phosphorus remains constant between the two examinations, and that the same bone areas have been measured. If the bone measured has increased in thickness, correction must be made for this; otherwise, a total increase in calcium and phosphorus might erroneously be interpreted as an increase in concentration of these elements.

The next problem to consider is: What error arises from absorption in the soft tissues? When x-rays pass through thicknesses of different absorbers, each one absorbs its proportion of the radiation incident upon it. Thus, if x-rays pass through a thickness T_1 of soft tissue whose linear absorption coefficient is μ_s, then through a thickness of bone whose thickness is T_2 and linear absorption coefficient μ_B, and finally through a second thickness of soft tissue, T_3, the total transmission is given by the equation:

$$I = I_0 e^{-(\mu_s T_1 + \mu_B T_2 + \mu_s T_3)} \quad (4)$$

where, as before, I_0 is the intensity of x-rays incident on the first surface of soft tissue and I is the intensity of the rays leaving the far surface of the soft tissue after passing through the part. If we were to compare the x-ray transmission of a long bone plus a thick covering of soft tissue with that of a phantom alongside of the part, and thus without any soft tissue, a very large error would result because, although the absorption coefficient of the soft tissue is considerably less than that of bone, the thickness would largely compensate for this. To overcome this difficulty, there are two possibilities. The first is to determine (in effect) the absorption coefficient of the soft tissue and then correct for the measured thickness of soft tissue surrounding the bone. The second is to balance out the absorption in the soft tissues. If the soft-tissue surfaces are flattened between parallel planes and a phantom is placed above this flattened area, the x-rays which pass through the bone and those that pass through the phantom nearby will have traversed nearly the same thickness of soft tissue. It is true that the x-rays which pass through the phantom pass through the full thickness of the soft parts between the parallel flattened surfaces, while those that pass through the bone pass through less soft tissue because the patient's bone is a space-taking structure. However, the bone marrow is probably similar in absorption to the soft tissue, so that the discrepancy actually amounts to the thickness of the cortex penetrated. This may introduce an appreciable error, but it tends to cancel out when estimations are made on the same patient, or even on different patients if the thickness of the bone cortex is essentially the same.

The x-rays, after passing through the patient and the phantom, are recorded on the roentgenogram. To interpret the findings properly, it is necessary to be familiar with the radiation characteristics of the film.

By means of a sensitometer (4), known amounts of x-rays at a specified kilovoltage are made to fall on various areas of a

film in a cassette. The film is then developed in the same way that the mineral-content-estimation films will be developed (preferably with agitation). After processing, each area which has been exposed to a known amount of radiation is measured with a densitometer. When the densities are plotted against exposures in milliroentgens on semilogarithmic paper, as in Figure 5, a characteristic curve is obtained, as shown. This curve has a gradually rising toe, a straight portion, and a sloping off knee at the higher densities. From such a curve, the speed, the latitude, and the contrast of the film and processing can be found. The contrast is proportional to the slope of the straight-line portion of the curve. It may be computed from the curve by finding two densities produced by two different exposures. The difference in these densities divided by the difference in logarithms of the two exposures gives the contrast, or *gamma*, as it is usually called. For example, at density 2.5, marked D on the extended line, the exposure is 10 milliroentgens. For density marked A, equal to 0.35, the exposure is 1 milliroentgen. Therefore,

$$\text{gamma} = \frac{2.5 - 0.35}{\log 10 - \log 1} = \frac{2.15}{1 - 0} = 2.15 \tag{4}$$

On the straight portion of the curve, between densities marked B and C, the density is proportional to the logarithm of the exposure. This relationship may be expressed by the equation:

$$D = G \log E + K_1 \tag{5}$$

where

D = the density produced by exposure E
G = the gamma or slope of the straight portion of the curve
E = exposure in milliroentgens on the film
K_1 = a constant (the value of D at 1 milliroentgen).

For Figure 5, G was found to be 2.15 and $K = 0.35$. Therefore,

$$D = 2.15 \log E + 0.35 \tag{6}$$

This applies only to the straight-line portion of the curve and thus to densities between B and C, *i.e.*, 0.7 to 2.0. It is important, therefore, in exposing the mineral-estimation film to obtain densities in the areas being measured, which lie between 0.7 and 2.0. The exposure on the film after passing through the patient is given by

$$E = E_0 e^{-\mu T} \tag{7}$$

which is equivalent to equation (1) for the exposure $E = It$ and $E_0 = I_0 t$, t being the time of the exposure.

Substituting (7) in (5) gives:

$$D = G \log_{10} (E_0 e^{-\mu T}) + K_1 \tag{8}$$

But

$$\log_{10} (E_0 e^{-\mu T}) = \log_{10} E_0 + \log_{10} e^{-\mu T} \tag{9}$$

and

$$\log_{10} e^{-\mu T} = 0.434 \log_e e^{-\mu T} \tag{10}$$

Therefore

$$\log_{10} e^{-\mu T} = -0.434 \mu T \tag{11}$$

Substituting (11) in (9):

$$\log_{10} (E_0 e^{-\mu T}) = \log_{10} E_0 - 0.434 \mu T \tag{12}$$

and substituting (12) in (8):

$$D = G (\log_{10} E_0 - 0.434 \mu T) + K_1 \tag{13}$$

For a given roentgenogram, E_0 (the exposure of x-rays on the patient) is constant, so $G \log_{10} E_0$ is a constant, say K_2. Equation (13) may be written

$$D = -0.434 G \mu T + (K_1 + K_2) \tag{14}$$

This equation is that of a straight line having a negative slope $= 0.434\ G\mu T$ and an intercept on the $T = 0$ line of $(K_1 + K_2)$. In spite of the fact that monochromatic x-rays are not used and that the ray is hardened in passing through tissue, the density *vs.* thickness of bone phantom is fairly close to a straight line, as shown in Figure 4. Note that the density range lies between 1.98 and 0.8, which is on the straight portion of the characteristic curve (Fig. 5).

SUMMARY

A method of estimating the mineral content of bone is described. It depends upon

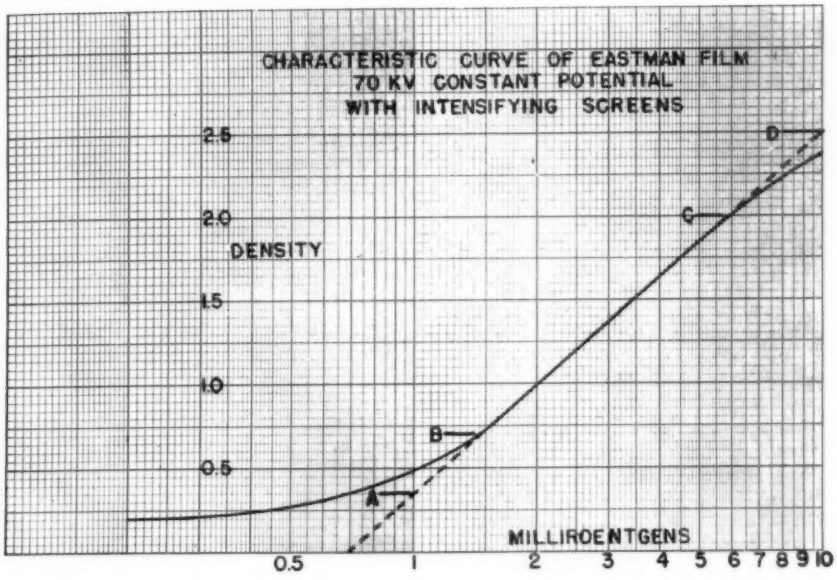

Fig. 5. The characteristic curve of Eastman film fully developed in Ansco developer. The latitude of the film lies between the exposures indicated at B and C.

a comparison between the absorption of x-rays in a bone of the patient and the absorption in a phantom placed over this bone. A roentgenographic film records the x-ray transmission within the shadows and a densitometer is used to measure the film densities. The characteristic curve of the processed film and its application to the method are discussed. Finally, the theory of x-ray absorption as used in this application, is developed. The curves obtained in practice are found not to deviate far from those indicated by the theory.

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SUMARIO

Cálculo Radiográfico del Contenido Mineral de los Huesos

La técnica descrita para estimar el contenido mineral del hueso se basa en una comparación entre la absorción de rayos X en un hueso del enfermo y en una sustancia fantasma colocada sobre el mismo hueso. Una película fotográfica registra la transmisión de rayos dentro de las sombras, empleándose un densitómetro para medir las densidades en la película. Discútense la curva característica de la película en uso y su aplicación a la técnica descrita. Por fin, se elabora la teoría de la absorción de rayos X, tal cual se usa en esta aplicación. Las curvas obtenidas en la práctica no se apartaron mayor cosa de las indicadas por la teoría.

(For Discussion of this paper see following page)

DISCUSSION

Ross Golden, M.D. (New York): In many cases of demineralization, the most marked effect appears at first glance to be manifested in the pelvis and the spine. I would like to ask whether Dr. Henny has evidence that the femur will reflect the same degree of demineralization which we think we see in the lumbar spine and pelvis.

Paul C. Hodges, M.D. (Chicago): Clinicians are eager for a method that will enable us to give them quantitative x-ray estimates of the extent to which the skeleton has gained or lost minerals and, as Dr. Golden points out, it is apt to be the spine and pelvis rather than the extremities in which interest centers. In the past, however, an increase or decrease in the thickness of overlying soft tissue has been able to simulate a change in skeletal density to such an extent as to make densitometer readings meaningless. If Dr. Henny's method compensates for this factor of the added effect of tissue density, then it may prove to be of real clinical importance.

Dr. Henny (*closing*): The question which Dr. Golden asks is a very interesting one, and it is one for which I have no answer as yet. I have been thinking about it but I have been trying to work out all of the details of the method first. Now we are ready to work on some of these other problems.

Regarding the soft-tissue compensation for loss in weight, it is true that this must be taken into account. One way that we hoped to do this was, at the first examination, to compress the patient's soft tissues appreciably and record the total thickness of the tissues. In the example that I showed, the thickness was 11 cm. Then we hoped, at the next examination, if the patient had lost weight, to be able to compress the tissue again to the same thickness, *i.e.*, to 11 cm. Now, if the patient has lost so much weight that in the compression to give sufficient flat surface, the soft-tissue thickness becomes less than 11 cm., I think that we're still not entirely lost. We are compensating for soft-tissue x-ray absorption in both examinations by measuring the density of the bone-phantom shadow in an area in which the x-ray penetrates approximately the same thickness of soft tissue that it does over the bone which is being studied.

Angiocardiography: Its Application to the Diagnosis of Coarctation of the Aorta[1]

BERNARD S. EPSTEIN, M.D.

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THE ADVENT OF surgical relief for coarctation of the aorta makes its diagnosis of more than academic importance (1, 2). The exact location of the constriction, the size of the aorta above and beneath the coarctation, the development of the collateral circulation, and the size and position of the innominate, the left common carotid, and subclavian arteries should be recognized radiologically. This may be done by angiocardiography, as in the three cases to be reported here, one in a forty-two-year-old woman and the other two in children, a boy of thirteen and a girl of fourteen years.

A modification of the Robb-Steinberg technic was used in which 14 × 17-inch cassettes were changed manually at intervals of one and a half to two seconds. A limiting cone confining the x-ray beam to the film area and protective side screens were provided.

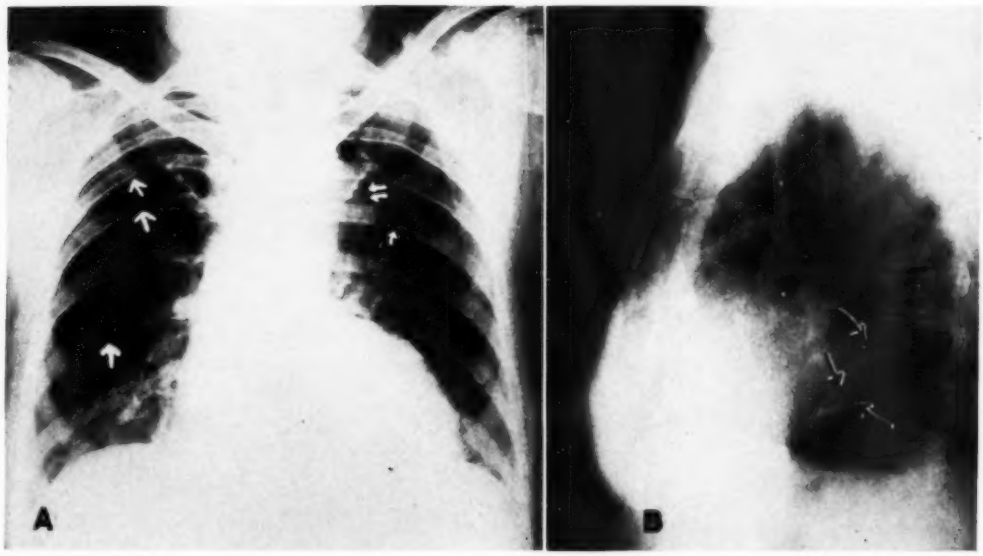

Fig. 1. Case I. A. Teleroentgenogram showing slight notching of the inferior surfaces of the ribs posteriorly. The notching appears somewhat more pronounced on the right side (white arrows). The heart presents considerable left ventricular enlargement. The aortic knob is prominent (double white arrow).

B. Left anterior oblique view showing the aortic arch. The aortic window above the left main bronchus is not unusual. The upper portion of the descending thoracic aorta is in its usual position. Its lower portion is displaced anteriorly, beginning approximately at the level of the left main bronchus (arrows).

CASE REPORTS

CASE I: R. R., a 42-year-old housewife, was first told she had hypertension during a pregnancy sixteen years earlier. A second pregnancy four years later was uneventful. There was a history of occasional palpitations but there had been no symptoms of heart failure or rheumatic fever. Physical examination showed the heart to be enlarged to the left. A loud precordial systolic murmur transmitted to

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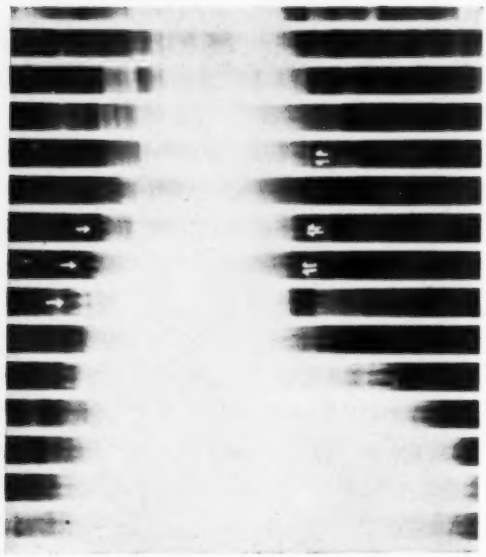

Fig. 2. Case I. Roentgenkymogram showing that the amplitude of pulsation of the ascending aorta (single arrows) is greater than that of the aortic knob and descending thoracic aorta (double arrows).

the neck and back was present. The blood pressure in the right arm was 216/126 mm. Hg, left arm 220/120, right leg 158/135, and left leg 160/135. Pulsations were felt in the femoral arteries. There were no visual evidences of collateral circulation.

Fluoroscopic and radiographic examination of the chest showed the lungs to be normal. Slight notching was observed on the postero-inferior aspects of the third to ninth ribs bilaterally. The left ventricle was considerably enlarged, and the right ventricle presented moderate anterior enlargement. The barium-filled esophagus was not displaced from its usual course. The ascending aorta was not dilated, but its pulsations were increased in amplitude as compared with the transverse and descending thoracic aorta, which were visible in the left anterior oblique position. The aortic knob was rather prominent and pulsated less vigorously than the adjacent aortic segments and the left ventricle. The lower portion of the descending thoracic aorta was displaced medially and anteriorly.

Angiocardiograms showed the right lower heart border to be formed by the right atrium. The superior vena cava and convex portion of the ascending aorta formed the upper part of the right cardiovascular outline. Immediately medial to the superior vena cava was the dilated innominate artery. The left superior mediastinal border was formed by the overlapping innominate vein and the dilated left subclavian artery. The latter was laterally convex and inclined medially and upward, presenting a nick as it passed from its aortic origin. The dilated left common carotid artery was medial to the left subclavian artery and was about half its size. Immediately beneath the left subclavian artery was the aortic knob, formed by the bending of the transverse thoracic aorta and the immediately adjacent descending thoracic aorta at the site of coarctation. Beneath this the shadow of the descending thoracic

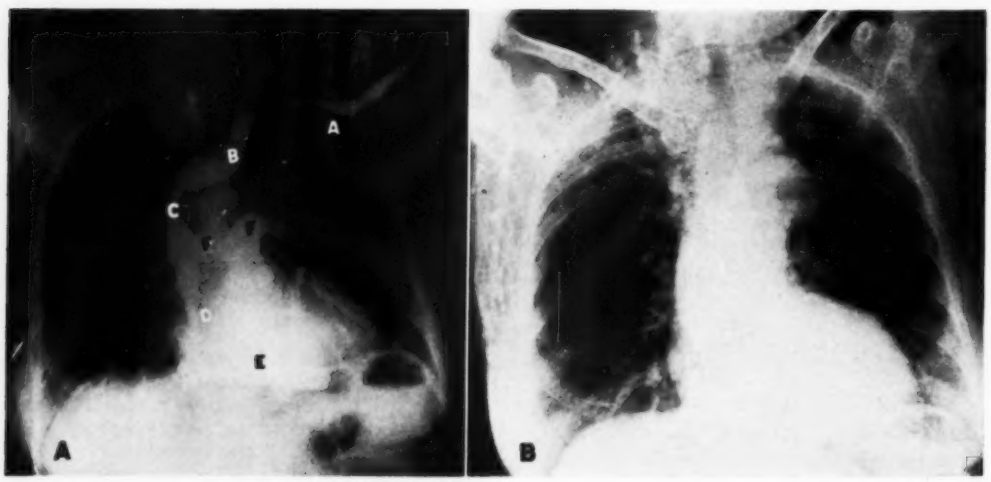

Fig. 3. Case I. A. Angiocardiogram showing diodrast in the left subclavian vein (A) and left innominate vein (B), the superior vena cava (C), the right atrium (D) and right ventricle (E), and the pulmonary arteries (F).
B. Angiocardiogram showing the pronounced collateral circulation in the supraclavicular and periscapular vessels. Note that this is more abundant on the right side. The axillary arteries are opacified. Dilated anastomotic channels are seen adjacent to the lower chest wall and some can be seen through the stomach gas bubble as well. The aorta is opacified in its ascending portion (see Fig. 4A).

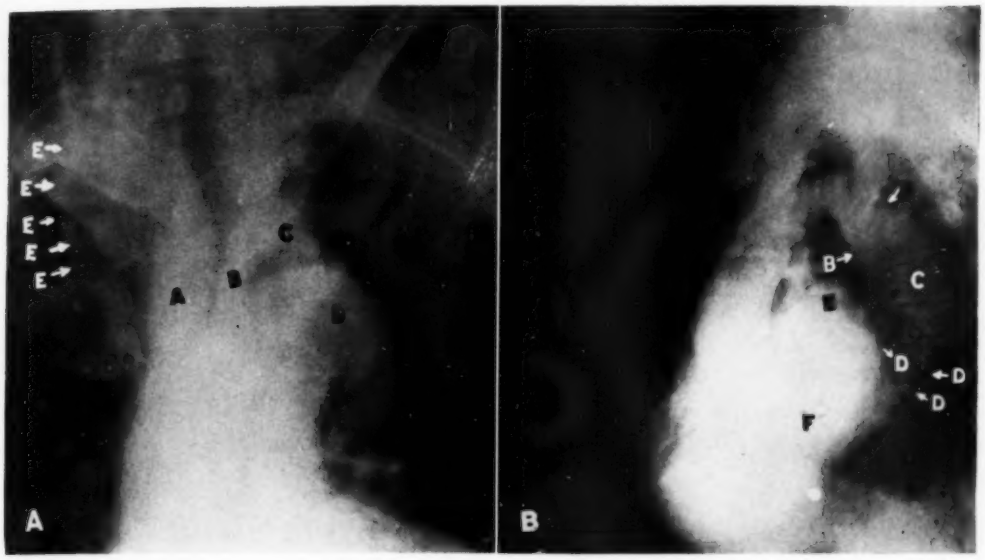

Fig. 4. Case I. A. Close-up of Fig. 1 E, to show the dilated innominate artery (A), the dilated left internal carotid artery (B), and dilated left subclavian artery (C). Note the medial inclination of the left subclavian artery. The ascending aorta is opacified so that the site of coarctation can be discerned by the change in density at the aortic knob (D). The right internal mammary artery is visualized just lateral to the head of the right clavicle (E).
B. Left anterior oblique angiocardiogram. Note the indentation in the aorta just distal to the origin of the left subclavian artery (A). Beneath this the aorta presents a downward bulge (B) in its lower border. The proximal thoracic aorta (C) is dilated, and the descending thoracic aorta is inclined anteriorly even though it is dilated (D). The left atrium (E) in diastole and the left ventricle (F) in systole contain diodrast.

aorta passed behind the heart. Lateral to the descending thoracic aorta was the main trunk of the pulmonary artery, and beneath this the left ventricle.

The site of coarctation was clearly seen in the left anterior oblique position. The aorta proximal and distal to the coarctation filled simultaneously and just distal to the origin of the left subclavian artery was sharply indented in the superior portion, forming a V-shaped depression. Beneath this depression, on the inferior surface of the aorta, was a downward bulge, probably at the insertion of the ligamentum arteriosum.

There was excellent filling of the supraclavicular, the suprascapular, and the infrascapular collateral circulation. The right anastomotic plexus exceeded the left in richness. The right internal mammary artery was clearly seen. The intercostal vessels were poorly opacified and were faintly seen on only one of the oblique angiocardiograms.

CASE II: T. R., a 13-year-old boy, had had hypertension, ascribed to congenital heart disease, since the age of three years. Coarctation of the aorta was diagnosed by Dr. Leon Goldenberg, who urged surgical intervention if the diagnosis could be definitely established. The patient was a well developed, intelligent lad who had rarely been ill. There were no indications of rheumatic fever or heart failure. The heart rhythm was regular. A harsh precordial sys-

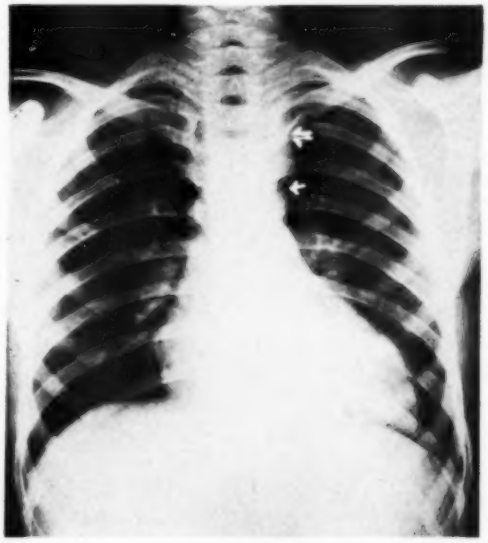

Fig. 5. Case II. Teleroentgenogram showing normal rib margins. The heart is enlarged slightly toward the left. The aortic knob is inconspicuous (single white arrow). Just above the knob is the convexity of the left subclavian artery (double white arrow).

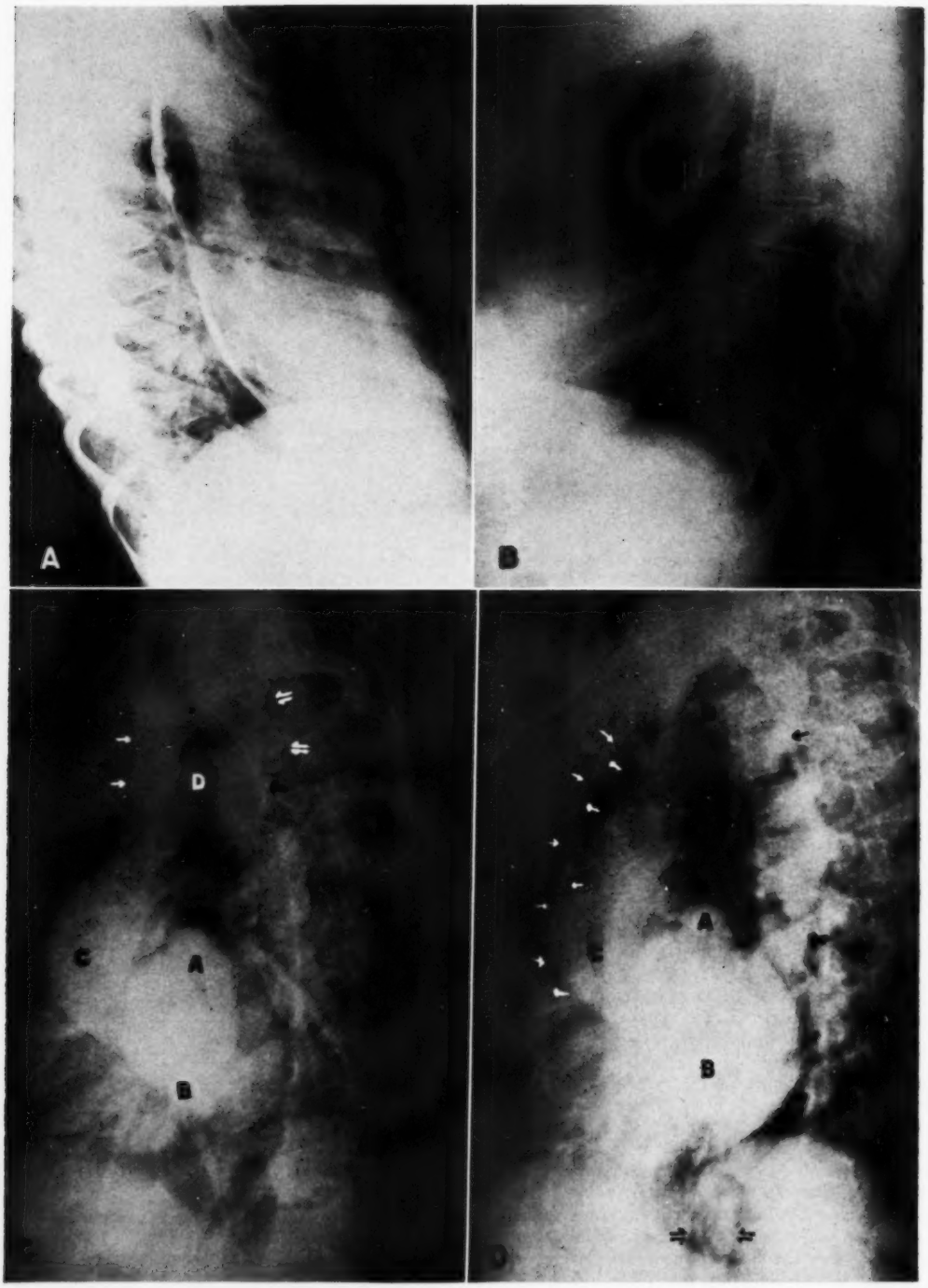

Fig. 6. Case II. A. Right anterior oblique esophagram showing no displacement of the barium-filled esophagus.
(*Legend continued on opposite page*)

tolic murmur transmitted to the axilla and neck was present. The blood pressure in the right arm was 169/100 mm. Hg, and in the left arm was 160/100. Pulsations and blood pressure readings could not be obtained in the lower extremities. Electrocardiographic findings were normal.

Fluoroscopic and radiographic examination of the chest showed normal lungs. No notching of the ribs was present. Immediately beneath the head of the left clavicle was a prominence with arterial pulsation. The aortic knob was inconspicuous and pulsated poorly. The left ventricle was slightly enlarged to the left. The barium-filled esophagus was in its normal position. The pulsations of the ascending aorta exceeded those of the descending aorta, the latter being estimated from the movements of the esophagus. The aortic arch and descending thoracic aorta were poorly portrayed, a rather common observation in children of this age group in my experience.

Angiocardiography showed no evidence of atrial enlargement. The ascending aorta was dilated and the aortic arch somewhat elongated. The dilated innominate, left common carotid, and left subclavian arteries could be demonstrated. The left subclavian artery revealed a curved prominence convex laterally. Several small convoluted anastomotic channels were present in both subscapular areas. The axillary arteries appeared dilated. The right internal mammary artery was opacified. The ascending aorta and aortic arch were seen on the six-second film, and the descending thoracic aorta on the next film, when the density of the proximal portions of the aorta had diminished. An indentation just distal to the origin of the left subclavian artery could be seen, indicating the site of the coarctation. The diameter of the ascending aorta about 5 cm. above its origin was three times that of the descending thoracic aorta opposite the ninth thoracic vertebra, where it measured 1.5 cm. in diameter. The intercostal arteries from the fourth to ninth intercostal spaces were opacified. These measured 2 to 3 mm. in diameter and were quite straight. They were separated from the rib margins by approximately 5 mm.

Operation was done by Dr. Robert E. Gross, who reported as follows: "A coarctation of the aorta was found about 1.5 cm. below the origin of the left subclavian artery. It was possible to free up the aorta and excise the narrow segment. Examination of this specimen showed a tiny opening no more than 2 or 3 mm. in diameter. It was possible to bring together the remaining ends of the aorta to perform a very satisfactory anastomosis and to establish an aortic pathway of perfectly normal size" (3). The patient has been restored to normal health.

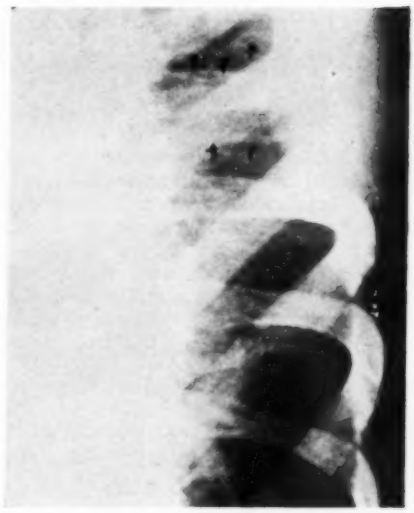

Fig. 7. Case II. Detail study of Fig. 6D, showing opacification of the intercostal arteries parallel to the lower rib margins. The uppermost intercostal artery is slightly convoluted (black arrows).

CASE III: D. R., a 14-year-old girl, was known to have congenital heart disease since infancy. Her mother had been informed that the blood pressure in the child's lower extremities was lower than in the upper extremities. Transitory episodes of faintness and dizziness had occurred during the past six months. The blood pressure in the right arm was 142/88 mm. Hg, in the left arm 140/86. The blood pressure in the lower limbs was not obtainable. A loud systolic murmur transmitted to the left sternal border was heard over the precordium. Superficial pulsations were seen in the intercostal spaces between the third, fourth, and fifth ribs bilaterally. Oscillometric studies showed diminished pulsations in the lower extremities, and the skin temperatures there were reduced.

B. Left anterior oblique view, showing no definite abnormalities.

C. Left anterior oblique angiocardiogram, showing diodrast in the left atrium in diastole (A) and the left ventricle in systole (B). The ascending aorta is opacified and is dilated (C). The aortic arch is faintly opacified (D), and the innominate (single white arrow) and the left subclavian arteries (double white arrow) can be seen. An indentation is present just distal to the origin of the left subclavian artery (black arrow).

D. Left anterior oblique angiocardiogram with the left atrium (A) in systole and the left ventricle in diastole (B). The aortic arch can be outlined but is less dense than in C (D, C). At the level of the interspace between the third and fourth thoracic vertebrae there is an indentation in the aortic arch just distal to the origin of the left subclavian artery, indicating the site of coarctation (black arrow). The descending thoracic aorta is opacified down to the level of the stomach gas bubble, and is smaller than the ascending aorta (double black arrows). The right internal mammary artery can be seen (white arrows).

Fluoroscopic and radiographic examination of the chest revealed no pulmonary disease or cardiac enlargement. The aortic arch did not appear unusual. No notching of the ribs was observed.

Angiocardiography showed the ascending aorta to be dilated. The transverse thoracic aorta was somewhat smaller in diameter, and at the origin of the left subclavian artery the arch was incompletely outlined. The descending thoracic aorta was not visualized until the next film, and was about one third the size of the ascending aorta. The subscapular and supraclavicular collateral circulation was not demonstrable, but the intercostal vessels could be seen as straight channels. The internal mammary artery could not be definitely identified.

DISCUSSION

Coarctation of the aorta occurs as the so-called "adult" type, in which the ductus arteriosus is closed, or the "infantile" type, usually associated with a patent ductus arteriosus and often accompanied by other anomalies. The adult form is compatible with long, active life, while patients with the infantile type rarely survive infancy. Surgical interest is focussed on the adult type since such possible sequelae as subacute bacterial endocarditis, aneurysm, and rupture of the aorta may be obviated by operation.

The common diagnostic criteria for coarctation of the aorta include dilatation of the ascending aorta, enlargement of the left ventricle, an inconspicuous or absent aortic knob, and notching of the posteroinferior rib margins. The transverse thoracic aorta and descending thoracic aorta may be difficult to identify (4). These changes reflect the hydrodynamic alterations secondary to an abrupt change in the caliber of the aorta. The degree of change varies considerably, inasmuch as the coarctation may range from a complete block to a slight indentation of no clinical importance (2). Notching of the ribs is seen only rarely in children (5).

Occasionally the left subclavian artery may be involved in coarctation of the aorta, and instances of involvement of the left subclavian artery alone have been reported (6, 7). In the former case notching of the ribs may be limited to the right side, while in the latter situation the blood pressures in the right and left arm may vary considerably.

Cases of coarctation of the aorta studied with angiocardiography are relatively few. The first was that reported by Nicolson in 1940 (8), in which the angiocardiogram was done by Robb and Steinberg. They described changes in the aortic arch, the presence of dilated vessels over the scapulae, and dilatation of the left subclavian artery. Grishman, Steinberg, and Sussman (9) reported two additional cases with narrowing of a segment of the proximal descending aorta. In one of their cases they demonstrated the dilated internal mammary artery on the right side. Their first case was also published by Blumenthal and Davis (10).

Keele reported an additional case in a 5-year-old boy (11), and Chavez, Dorbecker, and Celis studied a patient with coarctation of the aorta by means of angiocardiography by way of the jugular vein (12). Master reported one case of coarctation limited to the origin of the left subclavian artery, in which the angiocardiogram done by Dr. Marcy Sussman showed no filling of that vessel (7). Grishman, Sussman, and Steinberg described three cases of atypical coarctation of the aorta in which the angiocardiograms revealed relatively extensive involvement of the aorta at the isthmus and the distal arch, causing slight narrowing. No obstruction to the blood flow through the thoracic aorta could be demonstrated, but in each instance there appeared to be obstruction to the orifice of the left subclavian artery, resulting in almost complete absence of the radial pulse (13).

Pereiras and Castellanos performed retrograde aortography through the left humeral artery and described loops and whorls in the intercostal arteries which they considered to be due to the development of the collateral circulation. They mentioned that, even though some patients with this condition did not show notching of the ribs, the convoluted courses of these vessels indicated the probable presence of coarctation (14).

The advantages of angiocardiography in the diagnosis of coarctation of the aorta have been mentioned by Pugh (15), Crafoord and Nylin (2), Maire (16), Reifenstein, Levine, and Gross (17), and Neuhauser (5). Taussig (18), however, disagrees as to the advisability of angiocardiography for this purpose, since the diagnosis may be established by simpler means. She stated that, although the injection mass easily delineates the ascending aorta, it fails to pass into the descending aorta. This was not confirmed by our cases, in all three of which the descending thoracic aorta was opacified above and beneath the site of coarctation.

On the basis of his observations in three patients operated on for coarctation of the aorta, Gladnikoff (19) concluded that the left outline of the superior mediastinum is formed by the left subclavian artery. He also suggested that the lack of visibility of the aortic arch and descending thoracic aorta is due to the shortening effects of the reduced pressure in the aorta below the coarctation and, in addition, called attention to the inward, anterior, and downward pull on these structures by the shortened ductus Botalli usually present with aortic coarctation. He thus considered that the difficulty in visualizing the aortic arch is due to physiologic reasons rather than to any discontinuity of the structure. The cases reported here, particularly the first one, confirm his observations.

The size of the opening at the site of coarctation cannot be specifically observed even on the angiocardiograms. It may be significant, however, that in our first case the pre-stenotic and post-stenotic portions of the aorta were visualized simultaneously, and that the femoral pulses were palpable and measurable. The second and third cases had no femoral pulsations, and here the post-stenotic portion of the aorta was not visualized until after the diodrast had left the pre-stenotic portion. This may indicate that, if the opening is sufficiently large, diodrast passes through immediately, but if the opening is small the medium must reach the descending aorta through the collateral circulation.

The question as to why notching of the ribs is infrequent in children may possibly be answered by the observations reported here together with those of Pereiras and Castellanos. In our 2 young patients the intercostal arteries were straight and separated from the inferior rib margins. Pereiras and Castellanos reported that the intercostal arteries may become convoluted before rib erosions appear. Gross (1) mentioned that at operation the pulsation of the aorta beneath the coarctation was found to be distinctly less bounding than above, and that the intercostal arteries were dilated as they entered the aorta. Thus two factors may play a part in the evolution of the notching of the ribs: first, a time factor, operating so that a relatively long time interval is necessary before the arteries become sufficiently convoluted to impinge on the rib margins; second, a factor concerned with the pressure within the intercostal arteries. Although Gross makes no specific mention as to the pulsations seen in the intercostal arteries, it would appear reasonable that these would be the same as those of the adjacent aorta. It becomes apparent, then, that increased pulsation probably is not one of the factors, but rather that the increased flow of blood through the intercostal arteries is more likely the other cause for their convolution.

SUMMARY

Angiocardiographic observations in 3 patients with coarctation of the aorta are reported. The site of coarctation could be demonstrated in each, and the component parts of the heart and vascular pedicle were opacified. In addition, the collateral circulation and the descending aorta were visualized.

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SUMARIO

La Angiocardiografia: Su Aplicación al Diagnóstico de la Coartacion de la Aorta

Las observaciones angiocardiográficas descritas fueron ejecutadas en 3 enfermos con coartación de la aorta. En todos pudo observarse el sitio de la coartación, y se tornaron opacas las partes componentes del corazón y el pedículo vascular. Además, se visualizaron la circulación colateral y la aorta descendente.

Cavitary Disease of the Lungs

(Due to Less Frequent Etiological Factors)[1]

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A CAVITY IN THE lung is defined as an abnormal hollow space within the pulmonary parenchyma. It may be positively identified roentgenographically when it communicates with a bronchus because, under such condition, it is likely at one time or another to contain air, with or without a fluid level. A tuberculous cavity, the most common variety, forms when a caseous focus liquefies and ruptures into a bronchus. Among other causes for cavitation are aspiration pneumonitis, septic emboli, non-septic emboli which become infected, mycotic disease, foreign bodies in the bronchi or lung parenchyma, benign and malignant neoplasms.

Early recognition of the etiologic factor producing the cavity is of prime importance. It may be based on the roentgen appearance, frequency of prevailing diseases, and clinical course. Occasionally, however, difficulties may be encountered in early demonstration of the causative agent because of a paucity of differential diagnostic criteria, an aberrant clinical course, non-informative though well performed bronchoscopies, comparative rarity of the disease, or misleading gross appearance of tissues during a surgical procedure. The more unusual the etiologic factor, the less frequent will be an early etiologic diagnosis.

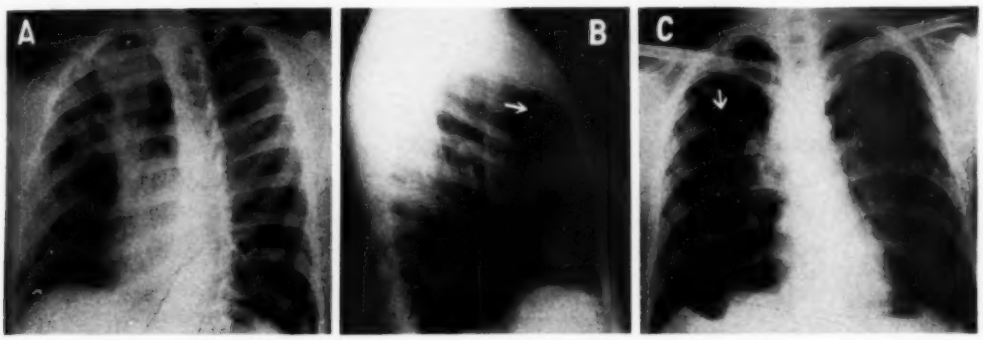

Fig. 1. Case 1: Hodgkin's disease
A. July 31, 1946. Left oblique projection of the chest demonstrating a large cavity in the right upper lobe, with a number of satellite cavities. They are surrounded by confluent infiltrations. Note resemblance to pulmonary tuberculosis.
B. Aug. 7, 1946. Anterior location of cavities.
C. Aug. 24, 1946. Note associated nodes in right hilus and paratracheal region. Arrow points to cavity.

Five cases will be recorded here with cavitation traceable to infrequent causes. Four of these presented difficult diagnostic problems.

REPORT OF CASES

CASE 1. A 26-year-old white male had a head cold and mild unproductive cough three weeks before admission to The Veterans Hospital. This was followed by blood-streaked sputum and a low-grade fever.

[1] From the Department of Medicine and Surgery, Veterans Administration Hospital, Bronx, N. Y. Published with permission of the Chief Medical Director, Department of Medicine and Surgery, Veterans Administration, who assumes no responsibility for the opinions expressed or conclusions drawn by the authors. Accepted for publication in January 1949.

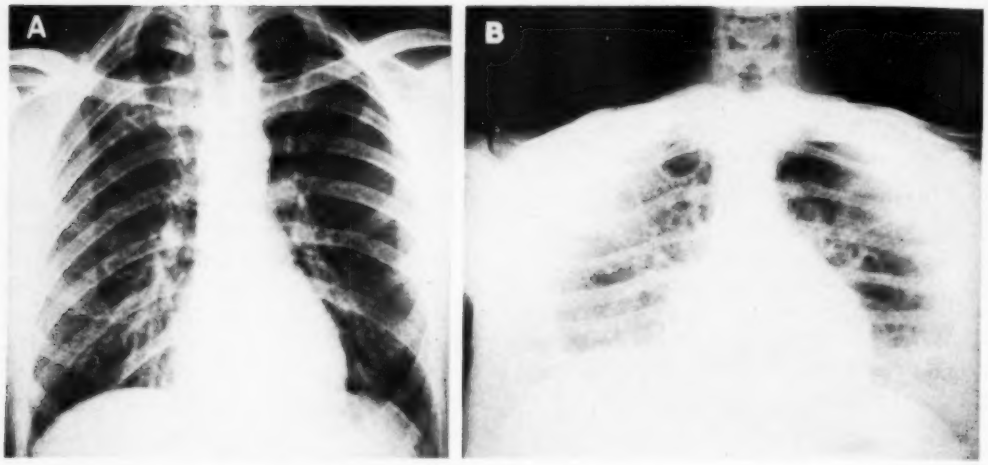

Fig. 2. Case 2: Coccidioidomycosis
A. Sept. 23, 1946. Thin-walled cavity in right apex, partially concealed by ribs and clavicle.
B. Nov. 15, 1946. Anteroposterior lordotic view, more clearly demonstrating the thin-walled cavity in the right apex.

Laboratory Findings: Chest films revealed infiltrations and cavitation in the antero-inferior segment of the right upper lobe (Fig. 1). Sputum was consistently negative for tubercle bacilli.

Essential Clinical Findings: Physical examination was negative except for clubbing of the fingers. There were no chest signs.

Clinical Course: The patient was admitted to the hospital Aug. 6, 1946, for the treatment of a lung abscess. Massive doses of penicillin and aerosol were administered. Operation for a non-putrid abscess was done Oct. 22, 1946. The involved lobe presented areas of softening surrounded by nodulations, with numerous succulent lymph nodes surrounding the trachea. Biopsy specimens were taken of lung tissue and a lymph node, and a diagnosis of Hodgkin's disease was established. The patient was given radiation therapy and nitrogen mustard. He ran the usual course of Hodgkin's disease, with remissions and exacerbations. Extensive osseous metastases later developed and death occurred June 24, 1948.

Comment: The most usual cause for fever, cough, and blood-streaked sputum is pulmonary tuberculosis or lung abscess. The roentgen findings early in the course of this disease were not unlike those of tuberculosis. Failure to demonstrate tuberculous organisms, however, led the clinicians to suspect a non-putrid abscess, and surgery was undertaken. During the surgical procedure, the type of lesion was not grossly recognized. The final diagnosis was made from the biopsy.

In retrospect, tracheobronchial node enlargement might have made one suspicious of neoplastic disease, but such enlargement is also encountered in tuberculosis and suppurative lung lesions. In any event, it is extremely rare for Hodgkin's disease to manifest itself by pulmonary cavitation, especially in the early stage.

CASE 2:[2] A 23-year-old white male was admitted to this hospital on Aug. 4, 1946, because of frequent bouts of hemoptysis and excessive weight loss. There was a history of army service in an area where coccidioidomycosis was endemic. Roentgenograms of the chest demonstrated thin-walled cavities in the right upper lobe (Fig. 2). An early etiologic diagnosis was, therefore, available from the history and roentgen appearance.

Pneumothorax for purpose of collapsing the cavity and arresting hemoptysis was unsuccessful on account of adhesions. Right upper and middle lobe lobectomy was performed on Nov. 20, 1946. At operation, the apex of the right lung was found firmly adherent to the cupola of the chest cage, and a clean thin-walled cavity about 3 cm. in diameter was present in the apical portion of the upper lobe. Pathologic examination of the operative specimen revealed endospores, confirming the diagnosis of coccidioidomycosis. Postoperative films showed no cavities in the residual lung (Fig. 3).

[2] Reported by Krapin and Lovelock in American Review of Tuberculosis, September 1948.

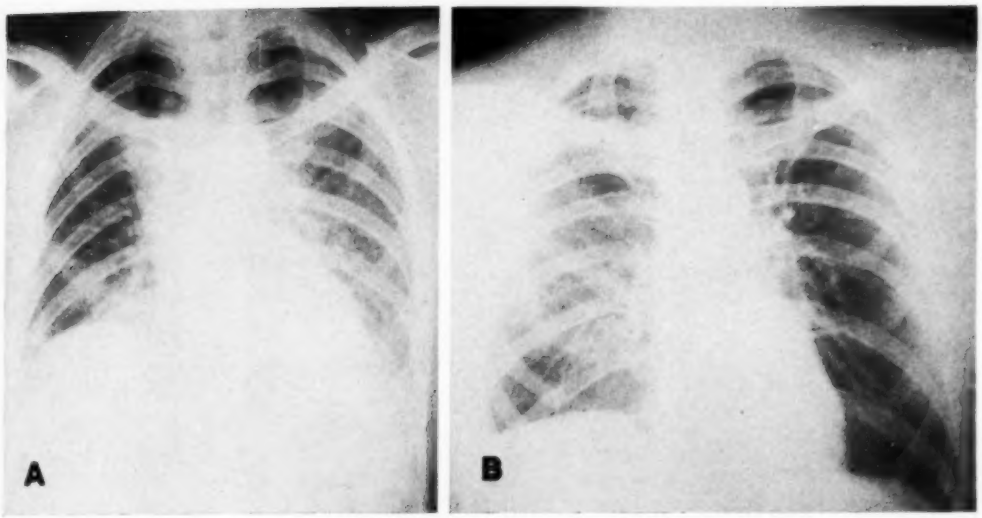

Fig. 3. Case 2: Coccidioidomycosis
A. Dec. 14, 1946. Postoperative film, showing right paramediastinal pleural reaction and compensatory emphysema of residual lung.
B. June 4, 1947. Pleurisy has subsided. No cavitations demonstrable in residual lung tissue.

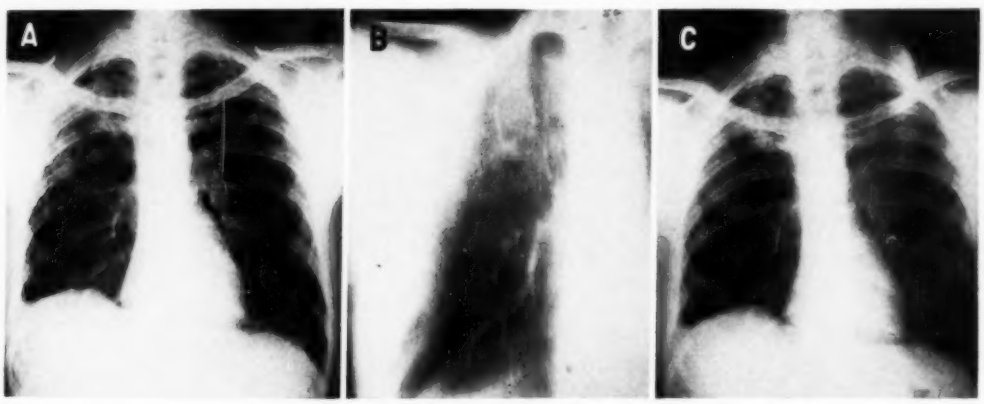

Fig. 4. Case 2: Coccidioidomycosis
A. Jan. 6, 1948. Recurrent cavities in the residual lung are clearly identified. They are more extensive than in the preoperative films.
B. Feb. 2, 1948. Tomogram of the same lung.
C. Feb. 10, 1948. Further demonstration of cavitations.

The patient was back at heavy work September 1947. Shortly thereafter his symptoms returned and he was readmitted to this hospital on Jan. 20, 1948, when x-ray examination of the chest demonstrated thin-walled cavities in the lower lobe (Fig. 4). A diagnosis was made of coccidioidomycosis of the residual lung on the basis of reactivation of previously quiescent and undemonstrated foci, due possibly to over-expansion of the right lower lobe following the upper and middle lobe lobectomy.

The patient was subjected to additional surgery, a first stage thoracoplasty on March 5, 1948, and a second stage thoracoplasty on March 19, 1948. He was discharged, with maximal hospital benefit, June 3, 1948, to be followed.

Comment: Cavities in coccidioidomycosis are neither infrequent nor difficult of recognition. They are characteristically thin-walled, resembling cysts or blebs.

This case is of interest because excisional surgery is rarely performed in this condi-

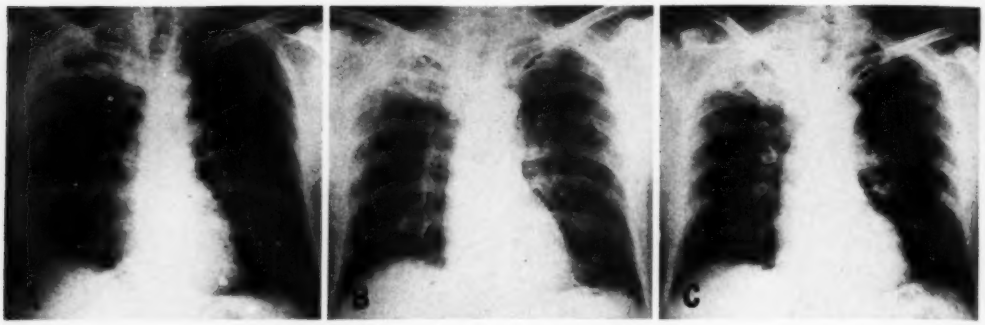

Fig. 5. Case 3: Aspergillosis
A, B, and C. Films obtained on Sept. 14, Oct. 20, and Dec. 10, 1947, respectively, demonstrating cavitation and infiltrations in the right upper lobe. The process is roentgenographically indistinguishable from tuberculosis. Indentation on the right side of the trachea is from an enlarged thyroid.

tion, and for the unique manner in which the subsequent cavities formed. It is pointed out in the literature that patients with coccidioidomycosis with cavitation are immune to "seeding" of other pulmonary tissue such as occurs in tuberculosis. This case, while not necessarily proving seeding, demonstrates the possibility of reactivation of pre-existing foci which cannot be demonstrated on the x-ray film. With the performance of excision, without an associated thoracoplasty, the unavoidable emphysematous changes of the residual lung may activate previously undemonstrated foci, as in this patient. In retrospect, therefore, it would have proved wise to do the thoracoplasty before new cavities were demonstrable.

It has also been stated that coccidioidomycosis cavities develop from central cavitations of nodules. In this instance, the mode of development was apparently different.

CASE 3. A 51-year-old white male complained of fainting spells and hemoptysis for many years. Chest films taken by the Health Department from 1945 to 1947 revealed infiltrating and cavitating pulmonary disease in the right upper lobe. The suggested clinical diagnoses ranged from arrested chronic pulmonary tuberculosis or far advanced pulmonary tuberculosis to neoplasm. Organisms could not be isolated.

Laboratory Findings: A large cavity was demonstrated roentgenographically in the right upper lobe, surrounded by confluent linear infiltrations. The roentgen appearance was that of pulmonary tuberculosis. The picture was further confused by a smooth indentation on the right side of the trachea caused by an extrinsic mass, probably of thyroid origin (Fig. 5).

Clinical Course: The patient was admitted to this hospital on Sept. 24, 1947. It was felt unlikely that a cavitating tuberculous lesion would yield a consistently negative sputum. The majority opinion was that the process was a suppurative disease and that surgery was indicated. It was also felt that the tracheal deviation was produced by an enlarged thyroid nodule which might have been responsible for the distal suppuration.

On Jan. 14, 1948, an exploratory thoracotomy was carried out. The right upper lobe was stony hard and densely adherent to the posterior portions of 2nd, 3rd, 4th, and 5th ribs, from which it could not be separated by blunt dissection. A right upper and middle lobe lobectomy was carried out, with resection of these ribs *en bloc*. The operative impression was carcinoma. Pathological study of the specimen, however, revealed chronic pneumonitis; *Aspergillus fumigatus* was obtained on culture, and microscopic examination revealed the presence of mycelia in the bronchial lumina. The final diagnosis was aspergillosis of the right upper lobe, and thyroid adenoma.

Comment: This patient had a pulmonary cavity from aspergillosis. Continued cough and hemoptysis simulate tuberculosis, and x-ray appearance of cavitation in the two diseases is indistinguishable. The palpable stony hardness of the tissues during operation misled the surgeons to believe that they were dealing with a malignant neoplasm. The diagnosis was belatedly arrived at only by pathological tissue culture.

In essence, the patient presented himself with a right-sided thyroid mass indenting the trachea, associated with an ipsi-

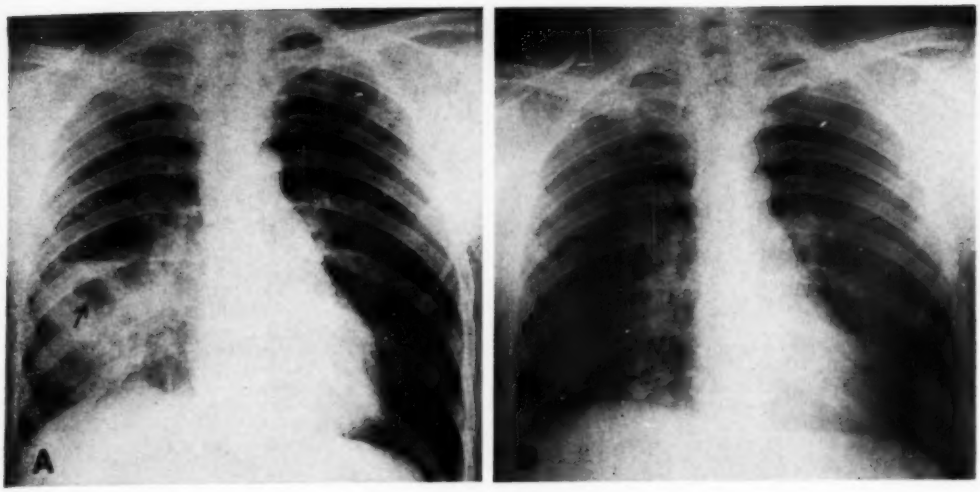

Fig. 6. Case 4: Foreign body

A. June 3, 1946. A large cavity is present on a level with the right fourth anterior interspace. There are dense infiltrations around the cavity, as well as hilar node enlargement. Arrow points to cavity.

B. Jan. 15, 1948. Pneumonitis noted on film June 3, 1946, has regressed. The cavity is no longer demonstrable. Right hilar node enlargement is still present.

lateral pulmonary cavity. Because of inability to isolate tubercle bacilli, the diagnosis of tuberculosis was rightly abandoned preoperatively. The surgery performed fitted the pattern of existing knowledge of the disease at the time of operation.

CASE 4: A 27-year-old white male complained of chronic cough and recurrent colds. In 1943, he entered a hospital for these symptoms, and there several bronchoscopies were done and two lipiodol bronchograms obtained, with subsequent thoracotomy in anticipation of a lobectomy. Because of adhesions, no excisional surgery was done. A postoperative bronchogram revealed bronchiectasis of the right lower lobe. Subsequently, the patient was studied at a second hospital, where seven bronchoscopies were done, one of which suggested the presence of a foreign body. Other examinations were compatible with granulomatous tissue, or possibly adenoma. None of the biopsies indicated adenoma. The patient brought up one to one and a half cupfuls of sputum daily.

Laboratory Findings: A roentgenogram obtained on June 3, 1946, showed a large cavity in the right lower lobe associated with surrounding dense infiltrations and enlarged nodes in the right hilus, and right diaphragmatic elevation (Fig. 6 A). Roentgenography on Jan. 15, 1948, revealed partial resolution of the pneumonitis but no cavity (Fig. 6 B). Right hilar node enlargement was still present.

Hospital Course: Following admission to the hospital in June 1946, the patient left against medical advice. His second admission was in January 1948, when he was coughing up large amounts of foul-smelling sputum. This was controlled by penicillin and aerosol. A bronchoscopy (Jan. 16) showed the right middle lobe bronchial orifice to be obscured and the right lower lobe bronchial orifice narrowed and reddened, with granular tissue on the posterior wall. From this region a purulent, bloody, foul-smelling exudate appeared. A biopsy from the area showed chronic bronchitis, exhibiting metaplasia. On Jan. 30, 1948, another bronchoscopy was performed, showing a grayish-pink mass in the right lower lobe bronchus at the level of the right middle lobe. It was felt that this represented a bronchial adenoma. A thoracotomy was performed, at which time it was noted that the entire right pleural cavity was obliterated by adhesions. A large mass was felt at the right hilus, which proved to be inflammatory lymph nodes. In cutting across the right lower lobe bronchus, a foreign body having the character of either a nut shell or lobster shell was found. A right lower and right middle lobe lobectomy was done, with a relatively uneventful postoperative course.

The pathologist's report was mucopurulent exudate, pulmonary atelectasis and fibrosis, dilated bronchi, and squamous metaplasia.

Comment: This patient had symptoms for seven years and presented a clinical course not unlike that of an adenoma. He was studied at three hospitals, subjected to surgery at two, and underwent bron-

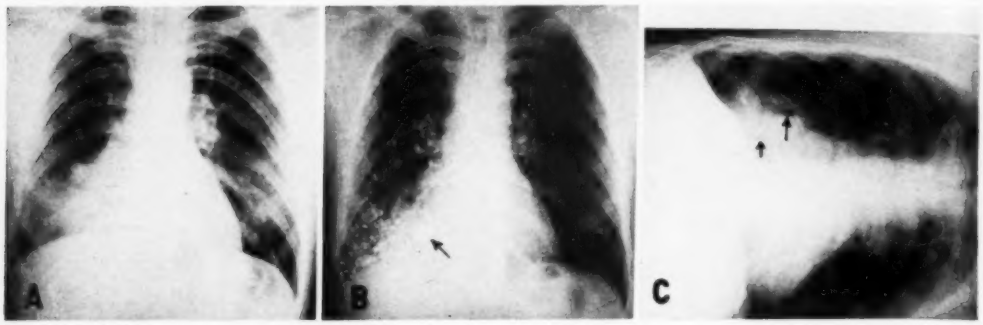

Fig. 7. Case 5: Bronchial adenoma (with eleven-year photographic record of cavitary disease)
A. Jan. 16, 1936. Note increased pulmonic density in the right paracardiac region produced by atelectasis and pneumonitis. Radiolucent areas represent cavitations.
B. Jan. 29, 1936. Bronchogram demonstrating one of the cavities communicating with a bronchus. Arrow points to lipiodol in cavity.
C. March 1, 1947. Left lateral recumbent postero-anterior projection showing a shift of the fluid levels with gravity (arrow).

choscopy nine times. The bronchoscopies, bronchograms, and biopsies were misleading and failed to reveal the etiologic agent, on account of the chronic pulmonary tissue reaction to the foreign body.

Radiopaque foreign bodies are easily recognized radiographically. Radiolucent foreign bodies manifest themselves by phenomena of bronchial obstruction. The x-ray appearance depends upon the size of the bronchus obstructed and the type of obstruction, complete or incomplete. Chest fluoroscopy and expiration-inspiration films can demonstrate only the existence of obstruction, which might be due to a foreign body, neoplasm or inflammation. The final causative diagnosis was therefore delayed until the patient was subjected to an operation.

CASE 5: A 45-year-old white male gave a history of pneumonia complicated by empyema of the right chest in 1919, when a thoracotomy had been performed. Following this, he had several episodes of hemoptysis, frequent colds, and repeated attacks of pneumonia, complicated by a chronic lung abscess of the right lower lobe. Treatment was conservative.

Since then, he had had a chronic cough, productive of large amounts of thick, green, foul-smelling sputum, and intermittent fever, anorexia, nausea, and vomiting. It was such an episode that caused him to enter Camp Kilmer Hospital on March 8, 1947. Penicillin therapy was administered for one week without relief of symptoms.

Essential Physical Findings: The patient was well developed, well nourished, and healthy appearing, with marked clubbing of the fingers. There was a foul odor to his breath and he expectorated large amounts of foul-smelling sputum. There was a well healed thoracotomy scar over the right 9th rib posteriorly. The left lung was clear to percussion and auscultation. On the right side there was diminished tactile fremitus, with dullness and diminished breath sounds.

Laboratory Findings: X-ray examination showed a large irregular area of pneumonic consolidation in the right lower lobe, containing a cavity with a fluid level (Figs. 7 and 8).

Clinical Course: The patient was admitted to the hospital in March 1947 and was given supportive therapy, which included postural drainage and penicillin. Bronchoscopy and aspiration were performed on May 2, 1947. Rib resection and thoracotomy drainage of the chronic lung abscess were performed May 16. Following this, the sputum cleared; it was no longer foul and was appreciably decreased in amount. Drainage from the thoracotomy gradually decreased. Postoperative roentgenograms showed a notable decrease in the size of the abscess and clearing of the old pneumonic process in the right lower lobe.

Because there were several abscess cavities in the right lower lobe, a lobectomy was done on July 11, 1947. A hard tumor of the right bronchus, some 4 cm. in diameter, just below the level of the orifice of the right upper lobe bronchus, was discovered. This was felt to be an adenoma or carcinoma and accordingly a right total pneumonectomy was performed. Pathologic examination showed it to be an adenoma of the right main bronchus, with multiple lung abscesses and bronchiectasis distal to the site of obstruction. The postoperative course was uneventful for a few weeks, but complications developed, necessitating further surgery. The patient was

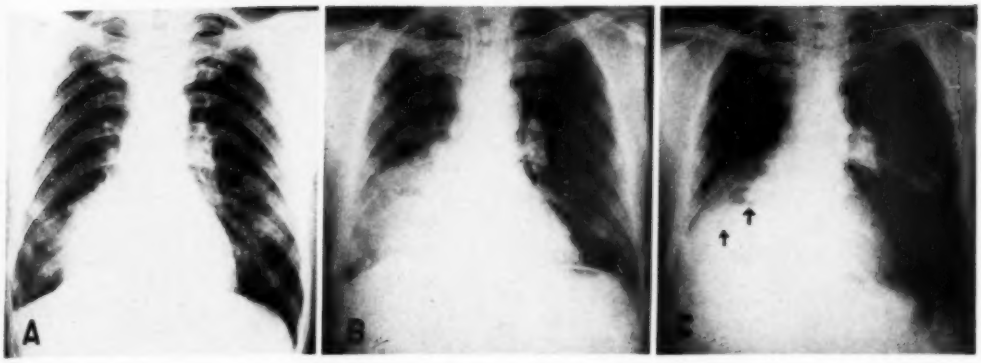

Fig. 8. Case 5: Bronchial adenoma
A. April 3, 1947. Cavity is not demonstrable.
B. April 18, 1947. A cavity with fluid level is apparent, and inferior to it a radiolucent area representing another cavity.
C. May 9, 1947. Note two cavities with fluid levels.

discharged on Sept. 25, 1947, asymptomatic and cured.

Comment: This man had a bronchial adenoma running a clinical course of twenty-eight years, characterized by hemoptysis, frequent colds, and repeated attacks of pneumonia. He was finally cured by extensive surgery. The symptoms resembled to a great degree those of the patient with the foreign body. This similarity of symptoms is easily understood when it is borne in mind that basically both had endobronchial obstruction, one from a foreign body and the other from adenoma. Both patients had cough, hemoptysis, pneumonias, and lung abscess. The x-ray appearance of cavitary disease also was similar. It is possible that further bronchographic study or body-section roentgenography might have led to identification of the tumor in Case 5.

SUMMARY

Five cases of cavitary lung disease of relatively rare etiology have been presented. The etiological agents, in order of presentation, were: (1) Hodgkin's disease, (2) coccidioidomycosis, (3) aspergillosis, (4) foreign body, and (5) adenoma.

CONCLUSIONS

1. Cavitary disease of the lungs may be produced by different pathologic agents.

2. An early specific diagnosis may not be arrived at, on account of the relative rarity of the disease and the similarity of the roentgen appearance in different pathological conditions.

3. A syndrome of fever, cough, and hemoptysis associated with cavitary lung disease is not always tuberculous. Failure to identify tubercle bacilli with diligent examinations is sufficient reason for contemplating abandonment of a diagnosis of tuberculosis.

4. Cavities as a result of endobronchial obstruction from different causes can produce a similar roentgen appearance and clinical course.

5. An early etiologic diagnosis of a pulmonary cavity may alter the type and extent of surgery.

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SUMARIO

Enfermedad Cavitaria de los Pulmones, Debida a Factores Etiológicos Menos Frecuentes

Varias causas pueden producir cavernas pulmonares. El reconocimiento temprano del factor etiológico reviste importancia, pero puede demorarse por virtud de la relativa rareza de la enfermedad subyacente y la semejanza del cuadro roentgenológico con el observado en otros estados.

En presencia de fiebre, tos y hemoptisis, es probable que se imputen las cavernas a tuberculosis, pero si un examen adecuado no revela bacilos tuberculosos, hay que pensar en la posibilidad de que haya otra explicación.

Las cavernas debidas a oclusión endobronquial producida por distintas causas pueden provocar un cuadro roentgenológico y clínico similar, según sucedió en dos de los casos de los AA.: uno de cuerpo extraño y el otro de adenoma bronquial. Los otros tres casos de enfermedad cavitaria aquí descritos se debieron a enfermedad de Hodgkin, coccidioidomicosis y aspergilosis, respectivamente.

El diagnóstico etiológico temprano de las cavernas pulmonares puede determinar la forma de la operación necesaria.

Hamartoma of the Lung[1]

ERNEST A. BRAGG, JR., M.D., and GEORGE LEVENE, M.D.

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In 1904, Albrecht (1) proposed the term hamartoma for a benign mixed tumor occurring in various organs including the lung. According to him, hamartomata are not true tumors but rather tumor-like malformations due to abnormal mixing or development of the normal tissue components of the organ. This abnormality may be the result of variations in the quality, arrangement, or degree of differentiation of the tissues, or, sometimes, in all three.

For a long period following Albrecht's contribution there appears to have been little interest in hamartomata, particularly those of the lung. A search through the literature, however, reveals several articles dealing with pulmonary hamartoma, incorrectly referred to as chondroma. In 1926, Hickey and Simpson (2), under the title "Primary Chondroma of the Lung," reviewed 38 cases from the literature and reported 2 cases of their own. It is clear from their histologic descriptions that the tumors with which they dealt were typical examples of hamartoma according to Albrecht's criteria. In 1931, Klages (3) reported an additional case of "chondroma," diagnosed preoperatively by x-ray studies. Benninghoven and Peirce (4) summarized 8 more cases from the literature (including Klages') and presented 2 new cases, in one of which chondroma had been mentioned in the differential diagnosis preoperatively. Their pathologic descriptions were also typical of hamartoma. Goldsworthy (5) gave an excellent discussion of the histology of a "chondroma" of the lung found at autopsy. Womack and Graham (6) published an account of the pathology of a large number of lung tumors in which they attempted to squeeze virtually all pulmonary tumors, even bronchogenic carcinoma, within the limits of Albrecht's concept of hamartoma. In this they are clearly at odds with all other writers who have considered the subject, but among their cases they did include a few which belong in this category. McDonald, Harrington, and Clagett (7), in 1945, reported 23 cases from the Mayo Clinic, 20 found incidentally at necropsy and 3 correctly diagnosed before operation.

Without tabulation of all individual case reports there seem to have been about 100 cases of pulmonary hamartoma recorded in the world literature, most of them under the term chondroma. Approximately 75 were discovered at autopsy; the remainder were surgical findings. In the latter group, a correct preoperative diagnosis was made in less than 10.

From the small number of cases reported, one might conclude that hamartoma of the lung is a rare tumor, but careful study of the available information proves that this is far from the truth. McDonald *et al.* collected 20 cases from 7,982 postmortem examinations at the Mayo Clinic. On the basis of these figures, the incidence would appear to be 1 in 400 autopsies. As the authors mentioned, however, it is probable that in routine examination, when no lesion of the lung was suspected, some cases may have been overlooked, and the true figure is probably even higher. Stated differently, hamartoma of the lung is probably second only to bronchogenic carcinoma in occurrence. This statement may appear rash in view of the known higher frequency of bronchial adenoma in all thoracic surgery clinics, but the discrepancy is only apparent. It may be explained by the fact that bronchial adenoma, because of its more rapid growth and usual location in one of the larger bronchi, usually attracts attention by obstructive symptoms or

[1] From the Department of Radiology, Massachusetts Memorial Hospitals, and Boston University School of Medicine. Accepted for publication in January 1949.

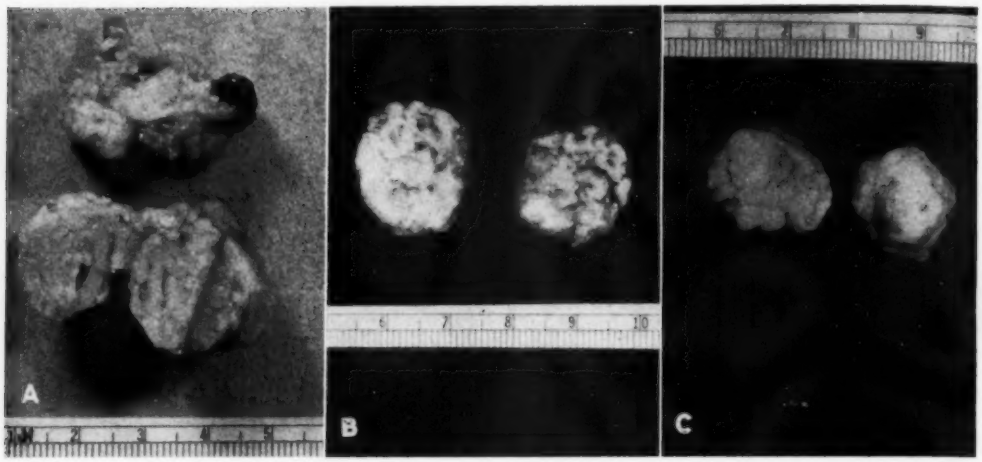

Fig. 1. Gross appearance of the hamartomas of the lung in the cases reported. All present an irregularly lobulated contour and show islands of glistening white hyaline cartilage separated by partitions of other tissues.

bleeding. Hamartomata are commonly located subpleurally and grow very slowly, so that they are not likely to produce clinical signs or symptoms which would reveal their presence. In only one of the 23 Mayo Clinic cases, were there symptoms related to the hamartoma.

In the group reviewed by Hickey and Simpson there were 26 males and 6 females (sex of the patient was not mentioned in a few instances). Of the cases reported by McDonald, Harrington, and Clagett, 17 were in males and 6 in females. The sex incidence in other series seems to coincide with this ratio of 3 or 4 males to 1 female.

No significant distribution according to age was noted; patients in the series reported by McDonald *et al.* ranged from twenty-one to eighty-five years and in that by Hickey and Simpson from nine to eighty-seven years.

The distribution of hamartoma in the lungs appears to be roughly proportionate to the relative size of the different lobes, the right lower lobe being the most common site. All series reported show the subpleural location to predominate. The size of the reported tumors varies from a few millimeters to a maximum of 9 cm. in diameter, with the majority ranging from 0.5 to 3.0 cm.

Most hamartomata of the lung present a characteristic gross appearance (Fig. 1). They are sharply limited and usually bounded by a definite capsule which strips easily. The contour is usually lobulated, but some tumors assume a smooth spherical shape. The cut surface is whitish, with the characteristic appearance of cartilage as the chief constituent tissue. Resistance to section is often encountered due to scattered patches of calcification or islands of bone.

The microscopic appearance (Fig. 2) is also characteristic and obviously different from any other pulmonary tumor. The most prominent tissue is cartilage arranged in the form of multiple islands or, less often, as a solid cartilaginous mass. The individual islands are usually separated by bands of connective tissue which tend to show mucoid degeneration, with an appearance similar to that of primitive mesenchymal tissue. Scattered about the tumor there may be small islands or crypts of epithelial or glandular tissue, similar to that in the small bronchi, lined by single layers of columnar or cuboidal cells which may be provided with cilia. Pockets of mucus may be produced by these glands. Groups of mature fat cells are often present in the peripheral portions of the tumor. Fibrous tissue, smooth muscle, and bone are sometimes observed.

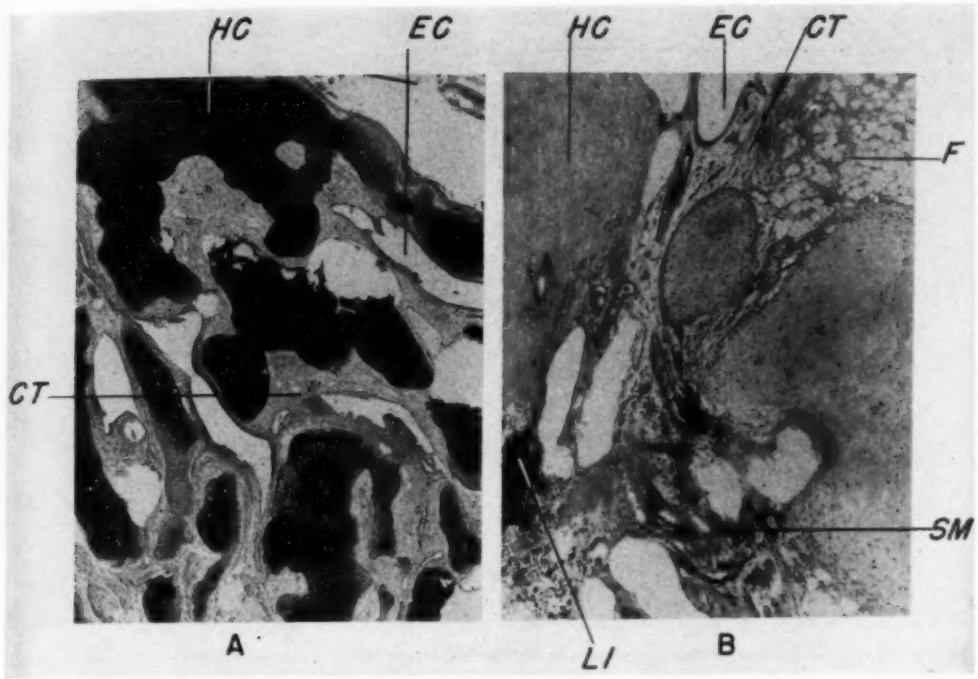

Fig. 2, A. Case 1: Note numerous islands of hyaline cartilage (HC) and epithelial-lined crypts (EC) scattered in matrix of loose connective tissue (CT). This is the characteristic structure of hamartoma of the lung. Hematoxylin and eosin. ×30.

B. Case 2: This single field shows a mixture of the common components of hamartoma: hyaline cartilage (HC), epithelial-lined crypts (EC), connective tissue (CT), fat (F), smooth muscle (SM), and lymphocytic infiltration (LI). Hematoxylin and eosin. ×100.

In the past, the majority of cases of hamartoma of the lung have been classified as chondromas because of the predominance of cartilage. It is probable that some cases in which the glandular elements predominate have been erroneously diagnosed as bronchial adenoma. Others may have been called dermoids, but the absence of any tissues not found normally in the lung should serve to distinguish a hamartoma from a true dermoid tumor. The incidence of the various tissues found in hamartomata is shown in Table I.

During the past year, 3 cases of hamartoma of the lung have been studied and surgically treated on the thoracic service of the Massachusetts Memorial Hospitals. All 3 were discovered incidentally on routine chest examination. These cases are reported as interesting examples of the problems which will be met with ever increasing frequency as a result of mass chest surveys.

TABLE I: INCIDENCE OF CONSTITUENT TISSUES IN HAMARTOMA (68 CASES)

	Hickey and Simpson	Benninghoven and Peirce	McDonald *et al.*
Number of cases	36	9	23
Cartilage	34	8	20
Connective tissue	24	7	Not given
Glandular tissue	15	8	21
Fat	15	8	14
Bone	7	2	2
Smooth muscle	2	3	2
Lymphoid tissue	1	7	Not given
Calcium (not bone)	6	Not given	Not given

CASE 1: P. F., a 50-year-old housewife and candy dipper, was admitted on the thoracic service in September 1947 because of a mass in the right lung discovered in a routine chest survey five weeks previously. She had no symptoms related to the tumor. Family and past history were non-contributory. Physical examination was essentially normal except for enlarged cervical nodes, more marked on the

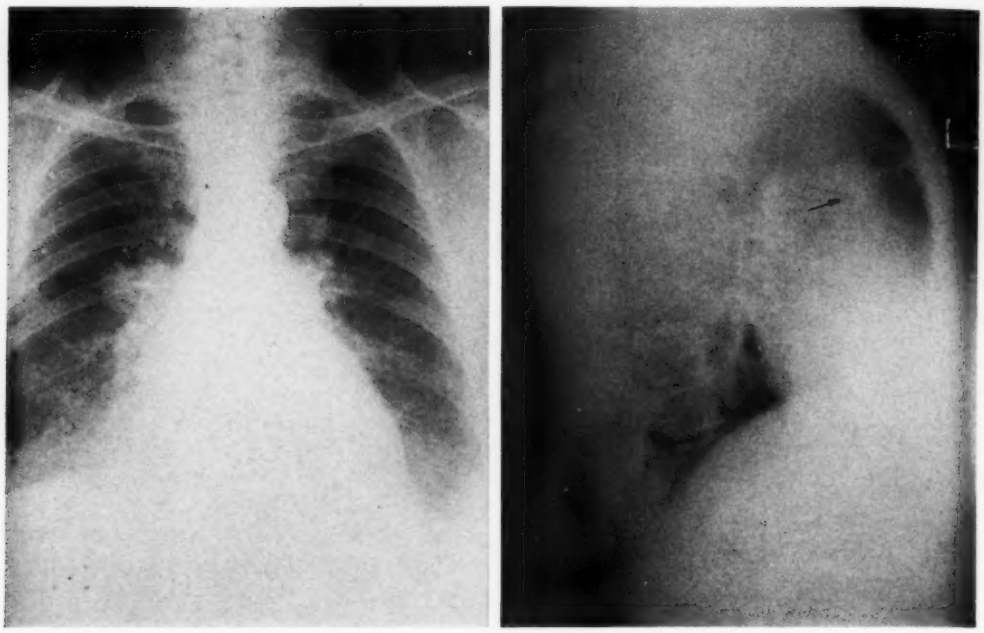

Fig. 3. Case 1: Lobulated tumor lying anterior and lateral to the hilus in the right upper lobe. Note area of atelectasis anterior to tumor, an unusual finding in hamartoma of the lung.

right side. Routine laboratory findings were normal.

Roentgen Examination: Postero-anterior and lateral views of the chest (Fig. 3) showed an irregularly ovoid mass, roughly 3 × 2 × 2 cm., lying just anterior and lateral to the right hilus in the base of the upper lobe. The mass was of homogeneous density and slightly lobulated contour, and seemed to have caused some atelectasis of the lung segment anterior to it. Bronchogenic carcinoma was considered the most likely diagnosis.

Bronchoscopic examination was negative.

On Oct. 8, 1947, *exploratory thoracotomy* was performed through the sixth right rib. A firm, irregular, easily movable mass was felt in the substance of the right upper lobe anteriorly, near the middle fissure. The lung was incised and the tumor shelled out. Frozen section and routine pathologic examination showed the typical findings of benign hamartoma of the lung. The gross appearance of the tumor is shown in Figure 1A.

CASE 2: M. H. W., a 47-year-old white housewife, was admitted on the thoracic service in January 1948 because of a tumor of the lung discovered in a routine chest survey four months previously. She had no symptoms related to the tumor. The family history was non-contributory. The patient had pneumonia at the ages of one and two. She had had hay fever for the past fifteen years and anginal symptoms or neurocirculatory asthenia for the past ten years. Physical and laboratory findings were essentially normal.

Roentgen Examination: Postero-anterior and lateral views of the chest (Fig. 4) showed a discrete, nearly spherical, homogeneous mass, about 2 cm. in diameter, lying in the left lower lobe posteriorly at the level of the ninth rib. Because of its sharp outline and lack of evidence of infiltration, obstructive changes, or hilar involvement, the tumor was thought to be benign, most likely a bronchial adenoma or tuberculoma. Hamartoma was mentioned in discussion, but was not seriously considered.

On Jan. 8, 1948, *exploratory thoracotomy* was performed through the sixth left rib. A tumor was palpated in the midportion of the left lower lobe. The lung was incised and an irregularly shaped firm tumor was spontaneously enucleated from its bed. Frozen section and routine pathologic examination showed the typical appearance of hamartoma, with islands of cartilage, myxomatous connective tissue, epithelial clefts with ciliated columnar linings, and small patches of fat and smooth muscle. The gross appearance is shown in Figure 1B.

CASE 3: A. G. M., a 51-year-old white male, was admitted on the gastro-enterology service in July 1948 because of intermittent epigastric pain of three years duration, with a definite duodenal ulcer demonstrated roentgenologically. The family and past history were non-contributory. Physical examination was essentially normal except for epigastric tenderness. The leukocytes were slightly increased, with a normal differential count; laboratory findings were otherwise normal.

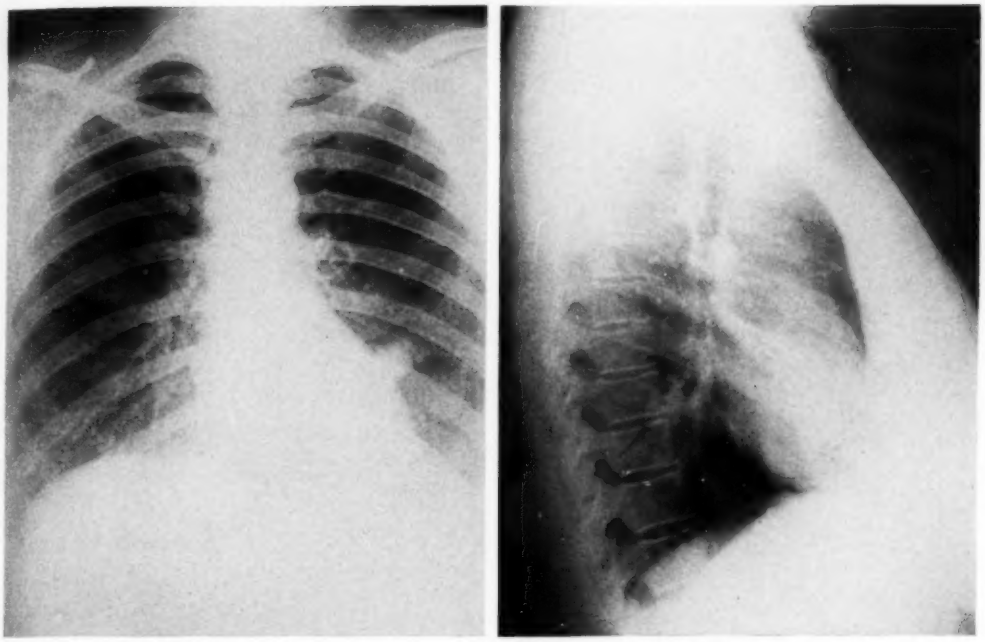

Fig. 4. Case 2: Discrete almost spherical tumor lying in the left lower lobe posteriorly. Note the absence of a reactive zone about the tumor.

Roentgen Examination: Routine chest films (Fig. 5) revealed a small tumor in the right lung; it was discrete, lobulated, and showed a few faint areas of increased density suggestive of calcifications within the mass. Hamartoma was immediately considered as a possibility, and laminagrams were made to demonstrate the calcifications within the tumor (Fig. 6). A definite diagnosis of hamartoma was made.

A week later, exploratory thoracotomy was performed through the seventh right rib. A lobulated tumor was felt in the apex of the right lower lobe. The lung was incised and the tumor shelled out. Both frozen section and routine pathologic examination were reported as showing hamartoma of the lung. The gross appearance of the tumor is shown in Figure 1C.

In all 3 cases, frozen section examination established the benign character of the tumor and permitted limitation of surgery to simple excision. All patients recovered rapidly following surgery.

Hamartoma of the lung is to be differentiated from other solitary discrete intrapulmonary tumors. Bronchogenic carcinoma in an early stage is certainly the most important lesion to rule out. A solitary pulmonary metastasis from an extrinsic neoplasm is also important, though this type of lesion is much less frequent. Calcifications within the tumor are strong evidence against a malignant growth arising in the lung and are rare in pulmonary metastases except from osteogenic sarcoma. Lack of clinical signs or symptoms and lack of appreciable change in size of the tumor in patients observed over long periods of time are also against malignancy.

Figure 7 illustrates a case in which routine chest examination revealed a tumor in a 56-year-old man admitted to this hospital for study of multiple sclerosis. This tumor was fairly discrete, and might be either a hamartoma or a bronchial adenoma as far as general appearance is concerned. The presence of calcified tuberculous lesions in both lungs made tuberculoma seem a likely diagnosis. Eight months later a repeat examination showed considerable increase in the size of the tumor. This rapid growth, with no clinical evidence of active tuberculosis, led to a diagnosis of bronchogenic carcinoma, which was soon confirmed by surgery.

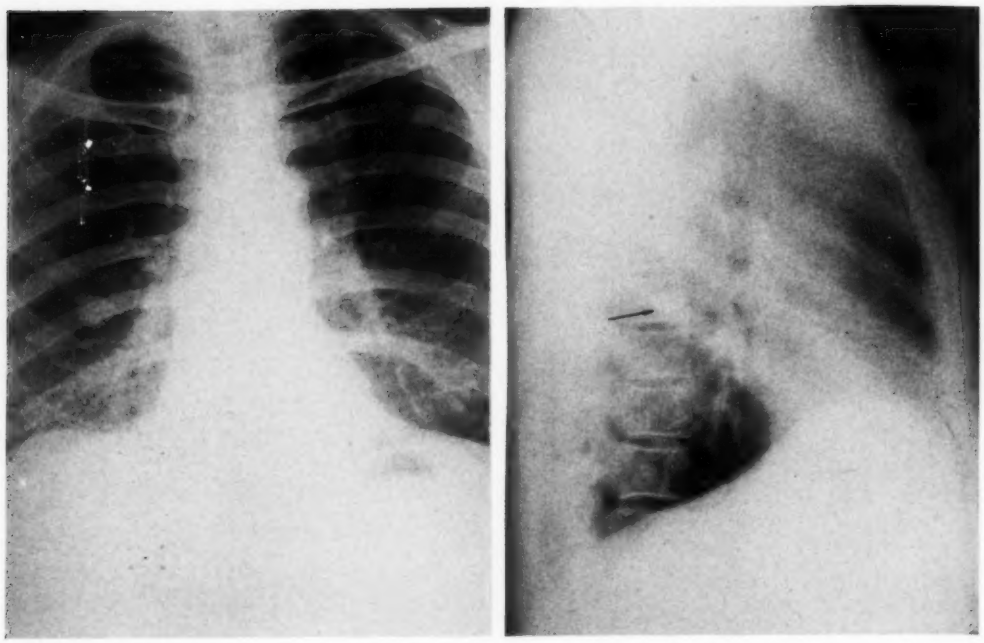

Fig. 5. Case 3: Definitely lobulated tumor in apex of right lower lobe, with faintly visible flecks of calcification (see Fig. 6).

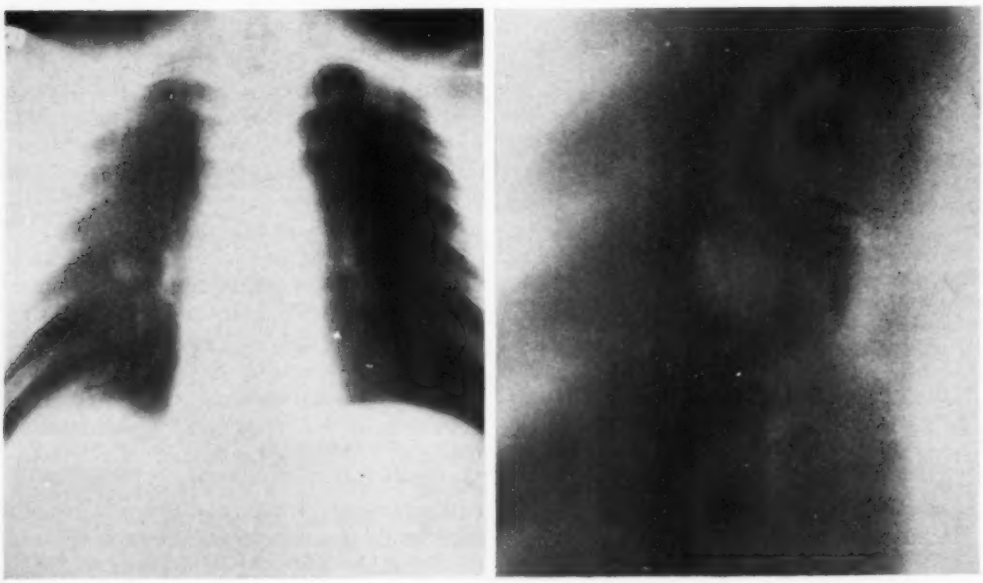

Fig. 6. Case 3: Laminagrams at level of tumor, clearly demonstrating the areas of calcification within the tumor.

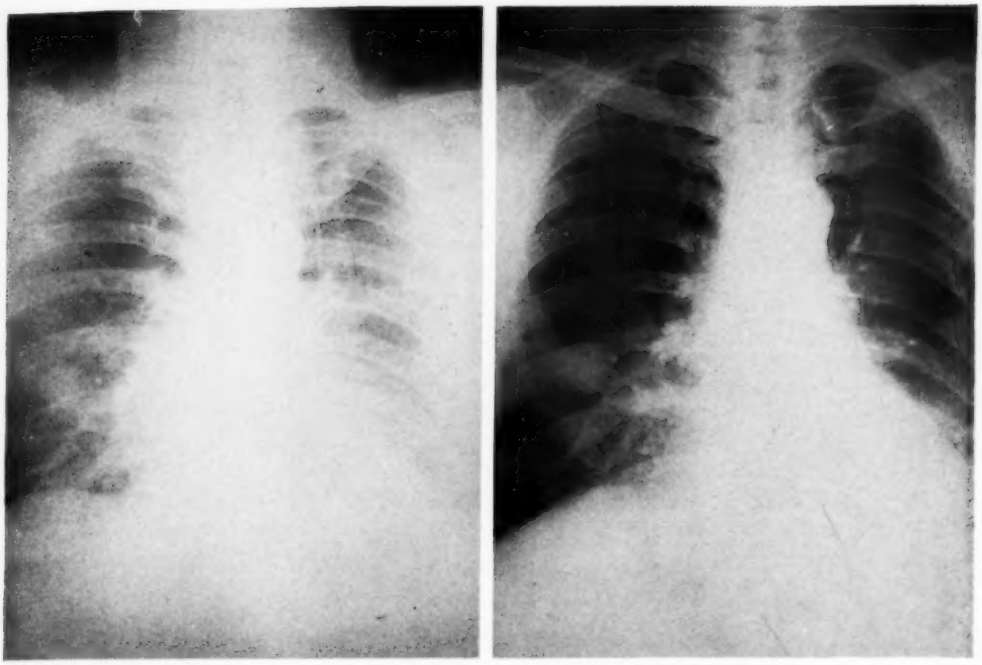

Fig. 7. Standard chest films taken eight months apart, showing growth of an incidentally discovered bronchogenic carcinoma which was first thought to be a tuberculoma. The definite increase in size during the period of observation excludes the probability of hamartoma.

Bronchial adenoma may resemble hamartoma, but is usually more spherical, closer to the hilus, and is more apt to cause obstructive changes.

Pulmonary tuberculoma may simulate hamartoma even to the point of calcific nodules within the mass, but is usually accompanied by other signs of chronic tuberculosis. When a hamartoma occurs in a patient with chronic pulmonary tuberculosis, it may not be possible to make the differentiation from tuberculoma. A tuberculoma which appeared somewhat similar to a hamartoma but subsequently identified itself by reactivation is illustrated in Figure 8. A useful point in identification of tuberculoma is the fact that there is usually a slight degree of surrounding inflammatory reaction so that the border of the mass appears hazy.

Benninghoven and Peirce considered solitary echinococcus cyst of the lung to offer the greatest problem in differential diagnosis and stated that such cysts are far more common than hamartoma. This impression is certainly not substantiated by our experience or by available figures on autopsies. Furthermore, the type of calcification which occurs in echinococcus cyst is usually so characteristic in distribution that it should not lead to confusion.

Another lesion of low incidence which might be mentioned in the differential diagnosis is the stasis infarct occurring in polycythemia vera. Hodes and Griffith (8) described these infarcts as discrete, spherical, sharply circumscribed pulmonary lesions with no surrounding infiltration. The marked increase of truncal shadows and vascular markings in such cases, with clinical evidence of cyanosis and vascular engorgement, should help in their identification.

The roentgen diagnosis of hamartoma is not always possible and rests heavily upon the presence of calcification within the tumor. The usual findings are as follows:

1. Sharply defined tumor in the lung

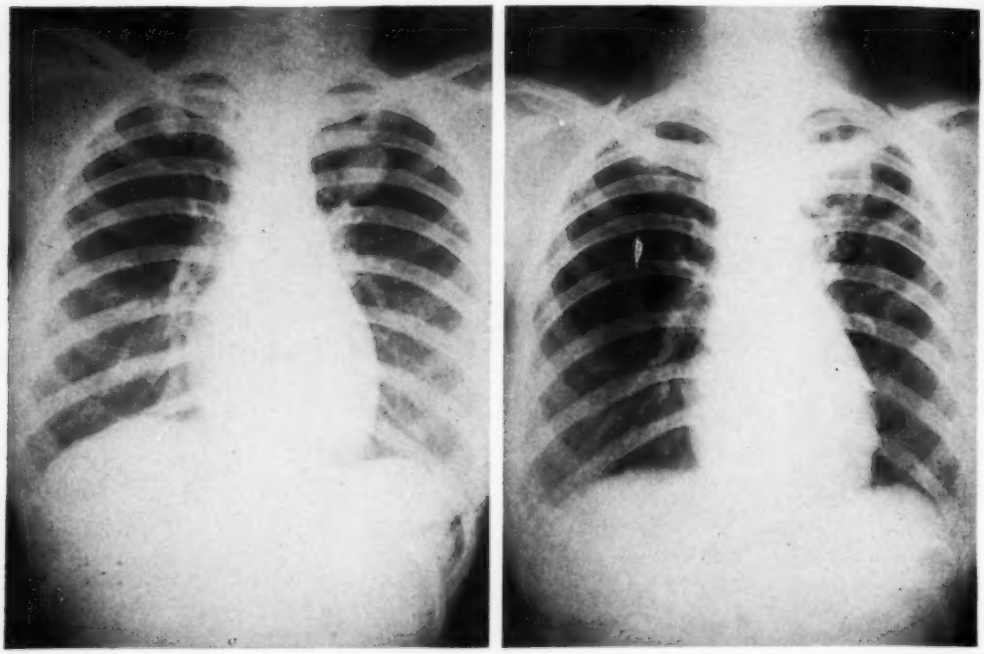

Fig. 8. Standard chest films of patient with large tuberculoma in left lung. The early film, on the left, shows the appearance of a tumor containing calcifications. Presence of other calcifications nearby is in favor of tuberculoma rather than hamartoma. The right hand film shows subsequent reactivation, with formation of a large cavity.

parenchyma with clear lung tissue surrounding it.

2. Lobulation of the margins in most cases.

3. Peripheral or subpleural location in most cases.

4. Irregular patches of calcification in many cases.

5. Areas of lesser density near the periphery of the tumor in some cases, due to collections of fat.

As benign tumors in which malignant degeneration is extremely rare, hamartomata of the lung will never be of great importance surgically in their own right. They are important in that current practice calls for exploration of all discrete pulmonary tumors other than those known to be of metastatic origin. With rising frequency of discovery of asymptomatic tumors in mass chest surveys, the incidence of surgical cases of hamartoma of the lung will increase sharply. By careful study, with laminagrams if necessary, it will be possible to identify a high percentage of these tumors before operation. It is probable that from time to time the radiologist can be of great service in diagnosing a hamartoma in a patient who because of age or illness would be a poor or unacceptable risk for surgery. In these circumstances a useless operation might be avoided and fear of malignant disease be eliminated.

SUMMARY

Pulmonary hamartoma usually occurs as a solitary, discrete, lobulated, solid mass, often containing calcific areas, situated in the parenchyma near the pleura, and surrounded by normal appearing lung.

Cartilage, primitive connective tissue, and islands of glandular tissue are the usual constituents, with fat, bone, smooth muscle, lymphoid tissue, and amorphous calcification occurring less frequently.

Hamartoma must be differentiated from bronchogenic carcinoma, solitary metas-

tasis, bronchial adenoma, tuberculoma, and echinococcus cyst.

Roentgen findings are: (1) sharply defined parenchymal tumor surrounded by clear lung; (2) lobulation of margins in most cases; (3) peripheral or subpleural location in most cases; (4) irregular patches of calcification in many cases; (5) areas of lesser density near the periphery of the tumor, occasionally, due to collections of fat.

Three cases discovered on routine chest examination and proved by surgery are reported. One of these was diagnosed roentgenographically with the aid of laminagrams.

NOTE: We wish to thank Dr. John W. Strieder, Chief, Thoracic Service, and Dr. Rudolf Osgood, Pathologist, for their cooperation and the use of clinical and pathologic material.

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SUMARIO

Hemacarcioma Pulmonar

El hemacarcioma pulmonar suele tomar la forma de una tumefacción maciza, lobulada, discreta, solitaria, conteniendo a menudo zonas calcificadas, situada en el parénquima cerca de la pleura y rodeada de tejido pulmonar de aspecto normal.

Los componentes habituales son cartílago, tejido conjuntivo primitivo e islotes de tejido glandular, observándose menos frecuentemente tejido adiposo, hueso, músculo liso, tejido linfoideo y calcificación amorfa.

El hemacarcioma tiene que ser diferenciado del carcinoma broncógeno, las metástasis solitarias, el adenoma bronquial, el tuberculoma y los quistes hidatídicos.

Los hallazgos roentgenológicos son: (1) tumor parenquimatoso bien definido y rodeado de tejido pulmonar despejado; (2) lobulación de los bordes en la mayoría de los casos, (3) localización periférica o subpleural en la mayor parte de los casos; (4) placas irregulares de calcificación en muchos casos; (5) zonas de menor densidad cerca de la periferia del tumor, debido, en ocasiones, a depósitos de grasa.

Los tres casos comunicados fueron descubiertos al hacer exámenes sistemáticos del tórax y fueron subsecuentemente comprobados al operar. Un de ellos fué diagnosticado radiográficamente con la ayuda de la tomografía.

Calcified Cyst of the Adrenal Cortex Without Endocrine Symptoms[1]

M. X. ANDERSON, M.S., M.D., HOWARD G. ROBERTS, M.D., and ERNEST T. SMITH, M.D.

SINCE CALCIFIED cysts of the adrenal are rare, it is believed that the following case is worth reporting.

Mrs. V. P. R., a 22-year-old Negro female, entered the hospital July 23, 1948. Six weeks before entry she had an attack of diarrhea lasting two days, with borborygmus and cramping abdominal pain. One month prior to admission "soreness" developed in the right upper quadrant, extending downward to the right iliac crest. This was aggravated by lying on the left side and by deep respiration. It was accompanied by stiffness and pain in the right arm, which was not relieved by aspirin. There was no vomiting, but anorexia and nausea had been present for three weeks. There was no dyspepsia. The patient had passed one tarry stool four months earlier. The stool was usually well formed and was often covered with a mucoid film. The menarche had occurred at seventeen and menstruation was normal except for dysmenorrhea for one and one-half to two years. There was a mild whitish intermenstrual leukorrhea. Appendectomy and right salpingectomy had been performed in 1946. A Bartholinian abscess was drained eight months prior to the present hospital admission.

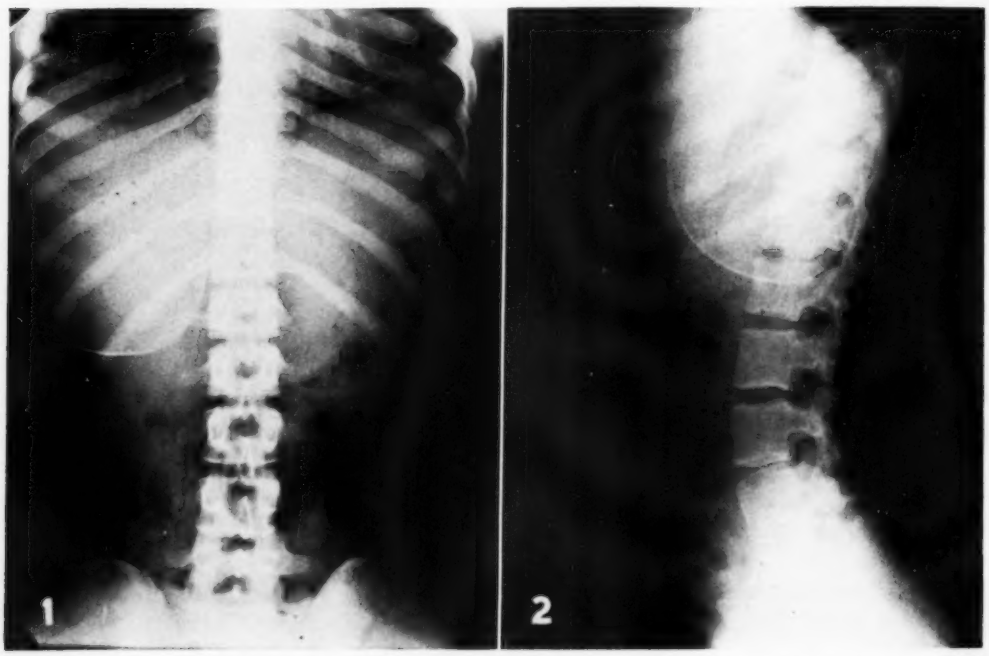


Fig. 1. Ovoid mass, 11.5 × 15 cm., in right upper quadrant. Note the thin calcific wall with flecks of calcium scattered throughout.
Fig. 2. Lateral view showing the posterior location of the mass.

The family history was in general non-contributory. The patient's father died of pulmonary tuberculosis, and his three sisters and one brother had tuberculosis.

The patient was well developed and well nourished, and in no acute distress. The blood pressure was 108/54, pulse 88, and respirations 18. The

[1] From the Department of Surgery and Radiology of the College of Medical Evangelists and the Los Angeles County Hospital. Accepted for publication in January 1949.

heart showed sinus arrhythmia, with the point of maximum impulse 2 inches lateral to the midclavicular line in the 5th interspace. There was reduplication of the pulmonary second sound and a blowing systolic aortic murmur was heard over the precordium, of slightly different tonal quality. Examination of the lungs revealed flatness below the right 4th interspacein the anterior, mid, and posterior axillary lines, with diminished breath sounds and vocal fremitus in this region. There was an area of tenderness measuring 5 cm. in diameter in the 4th interspace at the mid-axillary line.

The liver extended 3 to 4 cm. below the right costal margin, with moderate tenderness extending down the right side of the abdomen to McBurney's point. The spleen was not palpable. There was no rigidity or guarding, and peristalsis was active. The right costovertebral angle was slightly tender. Pelvic examination showed thickening of the right adnexa, second-degree retrodisplacement of the uterus, and a whitish purulent cervical and vaginal discharge.

On cystoscopic examination, Aug. 11, 1948, the bladder was negative. Indigo carmine appeared in four minutes on the left and in three and a half minutes on the right side. Culture of urine from the right kidney showed coagulase-negative *Staph. albus*, and from the left *Alcaligenes fecalis*.

Spinal puncture was performed on Aug. 5, 1948, because of headache, to rule out poliomyelitis, which was prevalent in Los Angeles at the time. Findings were essentially normal. Extensive blood studies

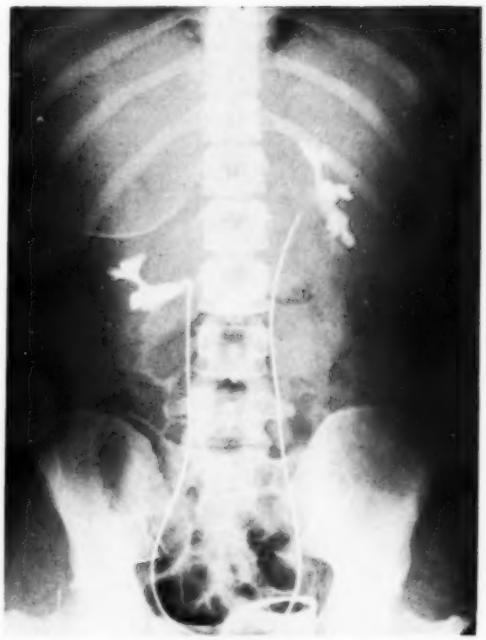
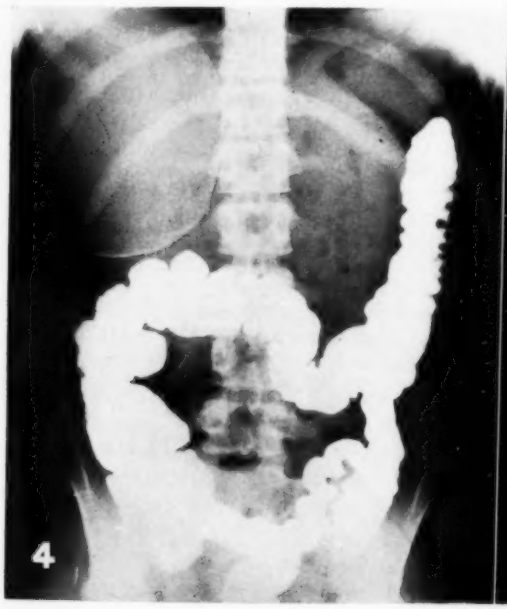


Fig. 3. Retrograde pyelogram (supine Trendelenburg). Right kidney is displaced inferiorly by the mass. No intrinsic defect in kidney structure (inferior calyx is incompletely filled).



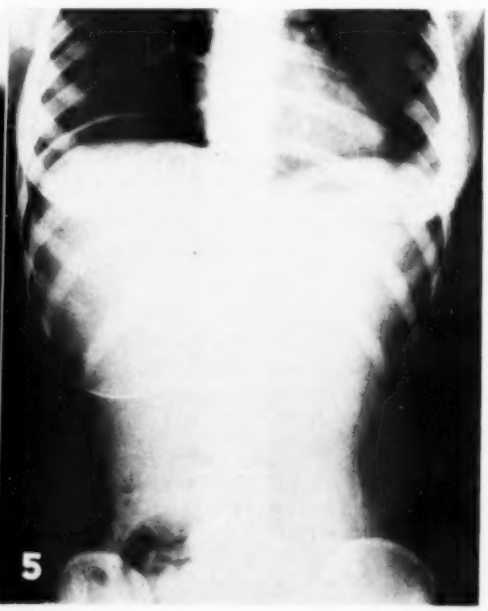


Fig. 4. Inferior displacement of hepatic flexure of colon by the cyst.
Fig. 5. Pneumoperitoneum (100 c.c. of air). Failure to outline the cyst with air indicates its retroperitoneal location (anteroposterior view).

Fig. 6. Surgical specimen of the cyst with adherent adrenal along the medial border. The kidney is loosely attached to the inferior aspect.

were also normal except for a slight anemia, with improvement following two 500-c.c. transfusions.

Stools were negative for parasites and occult blood. A skin test for echinococcus was negative. An electrocardiogram was within normal limits. Urinalysis was normal.

Roentgen Examination: A postero-anterior view of the chest, on the patient's first admission, Oct. 23, 1941, was normal. Anteroposterior and lateral films of the thoracic spine made at that time also showed no abnormality.

On the second admission, July 23, 1948, a postero-anterior roentgenogram revealed a normal heart and lungs. The diaphragm was normal in position and contour. Beneath it, on the right, was an ovoid tumefaction measuring 11.5 × 15.0 cm., with a thin calcific border (Fig. 1). In the region of this mass there were numerous small irregular densities of calcific appearance. A lateral view of the abdomen showed the tumor to be posterior in location (Fig. 2).

A barium-enema study revealed inferior displacement of the hepatic flexure, with no intrinsic lesion of the bowel (Fig. 4). Cholecystography showed a normally functioning gallbladder without evidence of displacement or calculi.

Retrograde pyelography demonstrated inferior displacement of the right kidney, without intrinsic defect of the pyelo-ureteral silhouette. With the patient in the Trendelenburg and the upright positions the relationship of the tumor and the kidney remained constant, indicating their intimate relationship (Fig. 3).

Perirenal air insufflation was felt to be contraindicated, since, as shown by Cahill, large tumors in the renal area enhance the danger of air emboli and hemorrhage following that procedure. Therefore, a diagnostic pneumoperitoneum was done. One hundred cubic centimeters of air were injected into the peritoneal cavity, and films of the abdomen were taken in the various positions (Fig. 5). Failure to demonstrate air around the tumor indicated its retroperitoneal location.

Operative Findings: On exploration of the abdomen, a cystic mass, 15 × 12 × 9 cm., firmly adherent to the upper pole of the right kidney, was found. There was no lymph node enlargement and no extension to the surrounding tissues. The kidney was displaced inferiorly, and the liver anteriorly and somewhat inferiorly, by the mass. The hepatic flexure was freed and the colon retracted inferiorly. The duodenum was displaced medially, after the manner of Kocher, giving an excellent exposure of the inferior portion of the cystic mass, as well as the kidney pedicle. The ureter, renal artery, and vein were doubly ligated and cut. The kidney with the adherent tumor was removed *en bloc* (Fig. 6).

Pathological Report: The kidney appeared normal except for a concave depression of the upper pole due to pressure from the cyst. The cyst measured 12 cm. in diameter and was roughly spherical in shape. An attenuated mass of adrenal tissue was clearly visible over the anteromedial portion of the cyst wall, in which it was apparently incorporated. The wall varied from 2 to 4 mm. in thickness, and the cut adrenal tissue was seen as a single flattened layer of adrenal cortex. Within this there was an irregular chalky zone of opaque white tissue which appeared to contain calcium. The cyst was loosely attached to the upper pole of the kidney and seemed to be quite separate from the kidney substance.

Microscopically the cyst wall was found to be composed of an outer layer of normal adrenal cortex, in some areas narrowed to a thickness of only two to three cells, and an inner layer of hyalinized fibrous tissue. Within this layer was a layer of amorphous, partly calcified material containing a few islands of adrenal cortical cells. There were some cells also within the calcified area described above. Masses of fibrin and a few red blood cells were seen in the cyst lining. *Microscopic diagnosis:* Adrenal cortical cyst. (Figs. 7 and 8.)

DISCUSSION

Cysts of the adrenal cortex are rare. The majority are small and have been diagnosed

Fig. 7. Microscopic section of the cyst wall showing (a) adrenal cortical tissue inside of (b) calcification of capsule, (c) fibrous capsule of the cyst with (d) adjacent adrenal cortex. Hematoxylin and eosin stain. ×24.

at autopsy rather than preoperatively. We have been able to find only one case (Levison, 8) of a large cystic tumor with sufficient calcium in its wall to make its diagnosis certain prior to surgery.

Levison has classified cysts of the adrenal into four groups: (1) true cysts, (2) cystic adenoma, (3) cystic lymphangiomas, and (4) pseudocysts. Satisfactory reports and descriptions of true glandular cysts were not found in the literature.

The cyst in Levison's case and in our own are believed to be examples of cystic adenoma. The former was "the size of a large grapefruit" and microscopic examination revealed that "the wall of the cystic tumor was made up of connective tissue. The contents of the cyst was a heterogeneous mass, whitish in color, somewhat gritty; this material took the stain intensely, and the grits were found to be lime granules, partly of lamellated, concentric structure. In the periphery of this mass were zones or patches of adrenal cortex or, perhaps more correctly, tissue of benign cortical hypernephroma; no sign of inflammation or malignant neoplasm was evident." Levison mentions 5 cases of cystic adenoma reported by Marchand, Askanazi, Manasse, Kelly, and Kelynach. Ballance (1) reported what appeared to be a cystic adenoma of the right adrenal, measuring 9 × 6 inches and containing about $2^1/_2$ pints of amber-colored, odorless, turbid fluid. Bourcy and Legueu (2) described a cyst of the adrenal cortex which contained five liters of cloudy fluid with a peculiar odor.

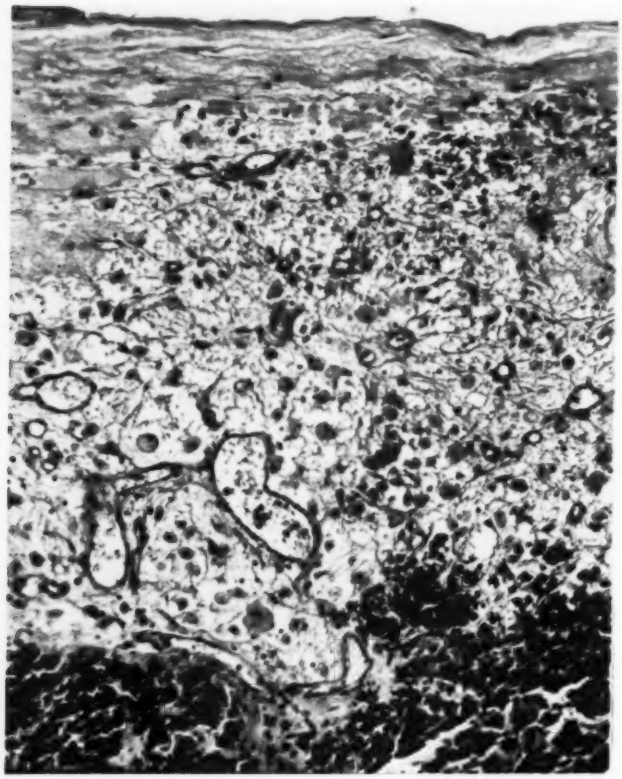


Fig. 8. High-power photomicrograph of cyst wall shown in Fig. 7. The adrenal cortical cells are within the calcified capsule. Hematoxylin and eosin stain. ×120.

In Rabson and Zimmerman's (10) case of cystic lymphangiectasia (cystic lymphangioma) of the left adrenal, "there were numerous spaces and cysts. The largest cyst was 1.2 cm. in diameter; however, most of the spaces did not reach a diameter of 1 mm. and were barely discernible with the unaided eye as pin-point pits in the solid tissue." The cysts of the right adrenal reported by Reimann and Guyton (11) ranged from 1 to 13 mm. in diameter. Calcareous deposits were present in the fibrous areas. In 7 cases seen at autopsy by Campbell (4) at the Babies' Hospital, "the cysts varied from 0.5 to 1.5 mm. in diameter."

Pseudocysts have been reported more frequently than the other types. In 1908 Doran (5) reported the successful operative removal of a cyst of the left adrenal which contained "half a pint of bloody fluid mixed with broken down tissue." In reviewing the literature, he cites a case reported by Greiselius in 1670, in which a cyst of the left adrenal ruptured and "12 pounds of red fluid and over 2 pounds of fetid clot had mostly escaped into the peritoneal cavity." Doran also gives short abstracts of 12 cases recorded prior to 1908, most of which were examples of pseudocysts. Pearse (9) reported a pseudocyst containing about "two quarts of bloody serum and about two quarts of clots" and "as large as an adult head or larger." Hartwell (7) also saw a cyst of the left adrenal which he described as being "as large as an adult head" and containing about 3 quarts of dark, reddish-black fluid with some thick masses of red fibrin which had the appearance of being digested.

SUMMARY

1. A case of calcified cyst of the adrenal cortex is reported. The patient, a 22-year-old Negress, sought medical care because of pressure symptoms. There were no hormonal changes.

2. Roentgenologic and operative findings are reported and the gross and microscopic appearances of the specimen are described and illustrated.

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SUMARIO

Quiste Calcificado de la Corteza Suprarrenal sin Síntomas Endocrinológicos

En el caso comunicado de quiste calcificado de la corteza suprarrenal, la enferma, negra de 22 años, buscó asistencia médica debido a síntomas de compresión. No habia alteraciones hormónicas.

Las radiografías mostraron un tumor ovoideo de 11.5 × 15.0 cm., de delgado borde calcificado, situado hacia atrás debajo de la porción derecha del diafragma. La pielografía retrógrada reveló desplazamiento inferior del riñón derecho y la observación en las posiciones de Trendelenburg y erecta demostró que el tumor y el riñón se hallaban en íntima relación. El neumoperitoneo diagnóstico estableció la localización retroperitoneal de la tumefacción.

El riñón y el tumor fueron extirpados quirúrgicamente. El quiste tenía 12 cm. de diámetro y mostraba una masa atenuada de tejido suprarrenal sobre la porción anteromedial de la pared del mismo. El diagnóstico fué confirmado microscópicamente.

Fetal Tolerance to Roentgen Rays

A Case Report[1]

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SUSCEPTIBILITY of the human fetus to the harmful effects of radiation has long been a matter of conjecture. Recorded observations indicate that the result of heavy dosage is unpredictable but may be disastrous. The occasional opinion that the small dose customarily used in diagnostic roentgenology may be harmful has not been confirmed by clinical experience. While there are extensive reports as to the harmful effects of large dosage, we are seldom presented with evidence that such effect is not inevitable. The case to be reported here is that of a human fetus subjected to a large dose of roentgen rays without apparent damage.

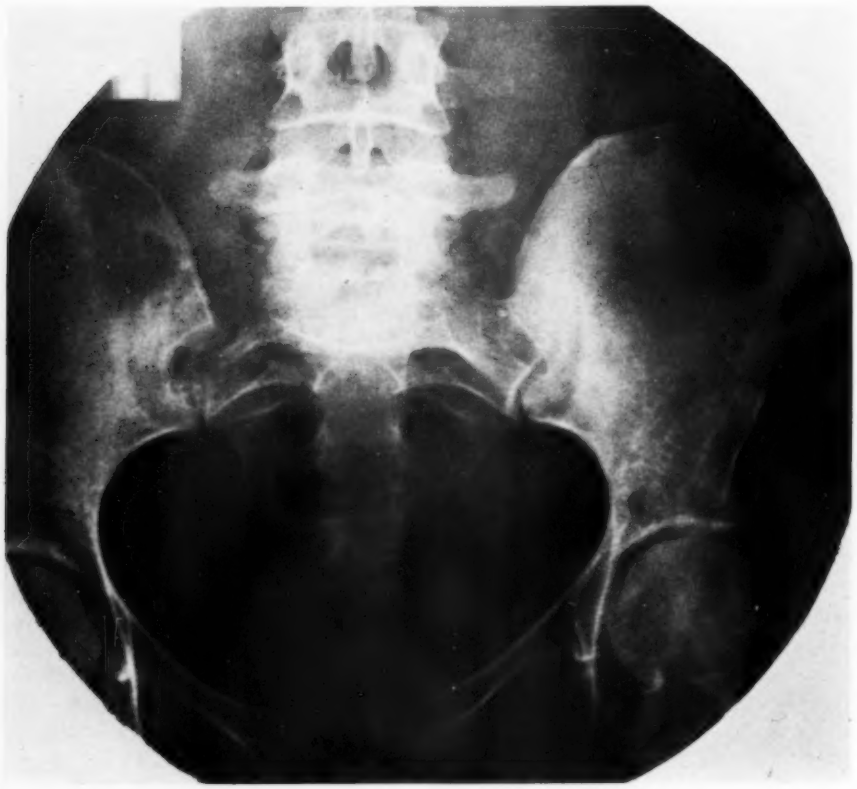

Fig. 1. Destructive lesion of the sacrum and right ilium. The uterus was at this time five and a half months gravid.

Mrs. G. E., aged 29, discovered a slightly painful small hard mass in her left breast on July 5, 1944, attributed to injury sustained on July 4. A radical mastectomy was performed on Aug. 19, and the anatomical diagnosis was adenocarcinoma. The

[1] Accepted for publication in January 1949.

regional nodes were involved, and surgery was followed by irradiation of the tumor bed, axilla, and neck.

The family history was negative for neoplastic disease or mental deficiency. During a ten-year period the patient had had six normal pregnancies, with all children living and well, ranging in age from nine to two years. She was again pregnant, the calculated approximate date of conception being June 1. At the time of mastectomy, therapeutic abortion was urged but was declined.

Low-back pain, beginning late in September, soon became severe and continuous. A roentgenogram made on Oct. 14 demonstrated an osteolytic lesion in the sacrum and right ilium. Surgical interruption of the existing pregnancy was again recommended and refused. It was considered that survival of the maternal patient for the full period of gestation was unlikely without treatment, or would be attended with too great distress. From Oct. 14 to Oct. 27, a dose of 1,500 r, measured in air, was delivered to each of two 15-cm. portals. The beams were directed dorsoventrally and ventrodorsally, respectively, with a half-value layer of 0.9 mm. of copper. The calculated mid-pelvic depth dose was 900 r. Not only was the pain poorly controlled, but the bone lesion actually increased in size during and after treatment (Figs. 1 and 2). From Jan. 13 to Jan. 17, 1945, additional radiation was directed to the dorsal field, thereby adding 375 r at the center of the pelvis.

On Feb. 16, pregnancy was terminated with the delivery by cesarean section of a male child having an entirely healthy appearance. Soon thereafter the osteolytic lesion in the pelvis of the mother healed; other lesions appeared in the skull and bones of the upper extremities, and these responded well to small x-ray doses. From May until October 1945, the patient was free from pain, was able to resume physical activity, and seemed well. In November there was evident liver metastasis and death occurred on Jan. 5, 1946.

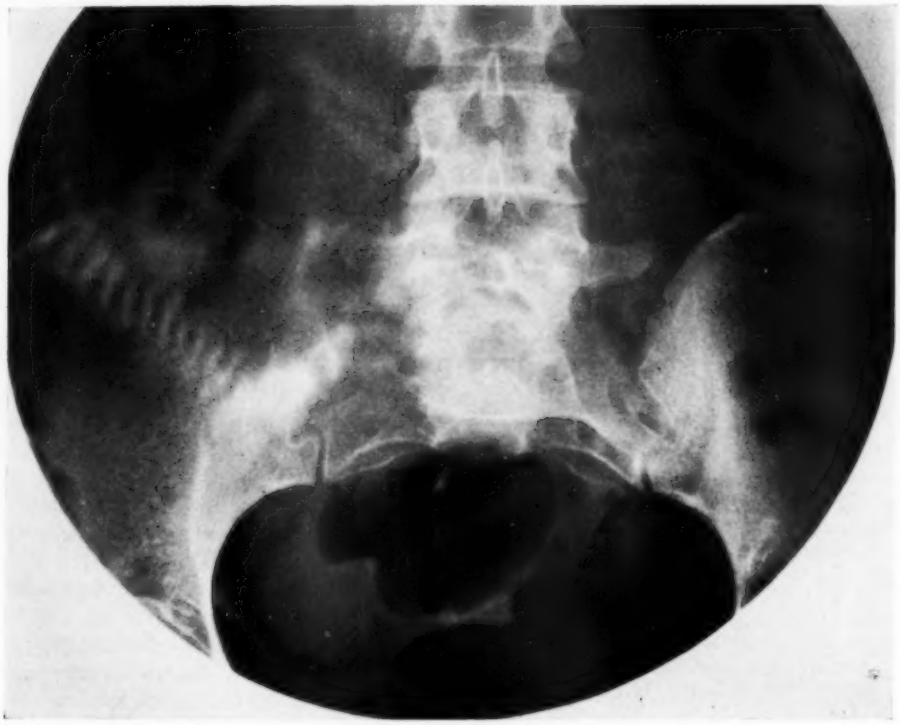

Fig. 2. Osteolytic pelvic lesion nearly four months after treatment. The roentgenogram was made three days prior to cesarean section. Fetal age was calculated as eight and a half months.

J. L. E., who was born by cesarean section on Feb. 16, 1945, is of scientific interest because of the absence of any apparent damage from a large dose of roentgen rays received prenatally, chiefly during the fifth fetal month. At birth he weighed $6\frac{1}{2}$ pounds, and no physical defect was found. The head was well covered with fine blond hair.

During the first year the child experienced measles and a gastro-intestinal disorder, both of which were mild. When he was thirty months old, he sustained

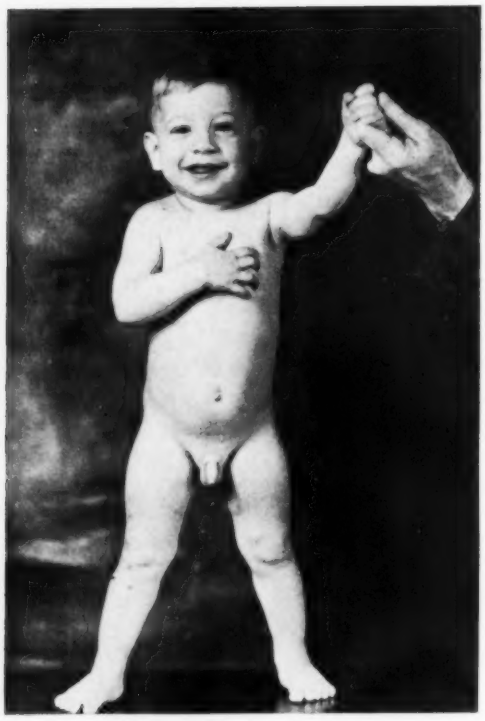

Fig. 3. J. L. E., sixteen months old, an apparently healthy child.

a leg fracture, the trauma being adequate and healing prompt. Lower central incisors appeared at five and a half months, followed in normal sequence by upper incisors and molars. The child was last seen by the author when sixteen months of age (Fig. 3). He then weighed 22 pounds and was 30 inches tall; his appearance was alert, his actions purposeful, and he was able to walk alone. He had twelve teeth; both testes were in the scrotum, and no physical defect could be found. The sagittal diameter of the skull was 14 cm. and the biparietal diameter was 11 cm. The father reports periodically by letter that the progress of this child is not significantly different from that of the six siblings. He first began speaking when nineteen months old, and now, as he approaches his fourth birthday, his mental and physical attributes are not such as to seem abnormal or unusual to an intelligent parent who had been warned to expect abnormalities as the result of prenatal irradiation.

REVIEW OF LITERATURE

Murphy (11) made a statistical study of 625 women who had received pelvic irradiation during pregnancy or prior to conception, and it was his opinion that irradiation of the pregnant woman is likely to be followed by the birth of seriously defective offspring, conforming to a type of which microcephaly is the most common manifestation. Murphy's observations have been confirmed by Jones and Neill (7), Glass (5), Maxfield (8), Archangelsky (1) and others. Miller, Corscaden, and Harrar (10) reviewed and summarized the pertinent literature prior to 1936.

Harris (6) and Mayer, Harris, and Wimpfheimer (9) reported upon the extensive use of roentgen rays in the therapeutic production of abortion. In a series of 200 cases, they found that 510 r administered at the depth of the gravid uterus within an elapsed time of two days would almost invariably cause death of the human fetus if the period of gestation were less than eighteen weeks, but that such method is not suitable in more advanced stages of pregnancy.

Hypotheses have been advanced as to the mechanism effective in producing fetal damage. Experimental work done on mice prior to fertilization of the ovum (2, 3, 4) indicates that direct injury to the gonad is responsible for a high rate of spontaneous abortion and for a high incidence of congenital deformity with a characteristic pattern and also with hereditary tendencies. There seems to be no parallel observation in clinical experience.

Miller, Corscaden, and Harrar, quoting Archangelsky, list four factors that may cause damage to the human fetus: (*a*) direct effect on the blood-forming organs, the lymphatic tissue, the endocrine system, and the central nervous system of the fetus; (*b*) indirect effect upon the uterine musculature and endometrium; (*c*) indirect effect upon the maternal ovary; (*d*) indirect effect upon the fetus of leukotoxins produced by radiation. The last hypothesis seems to be in some measure substantiated by reports of microcephaly following intensive irradiation of pregnant women where the rays have been applied at a distance from the gravid uterus, with the fetus and the maternal reproductive system well protected.

Glass had the opportunity of observing a microcephalic idiot who survived for thirteen years. The cause of mental and physical impairment was evidently prenatal irradiation. Significant postmortem findings were hypoplasia of the brain, external genitals and breasts, parathyroid adenoma, and bone marrow atrophy. The opinion is expressed that the significant damage is to the brain, thereby depriving the pituitary and related endocrine glands of the integrating function of the hypothalamus.

Jones and Neill estimate that the incidence of mental deficiency after irradiation of the fetus with doses commonly used in the treatment of pelvic cancer is about 20 per cent when the fetal age is not greater than five months. Among the various authors quoted, there is universal agreement that danger of causing physical damage and mental deficiency in the offspring is such that the pregnant woman should not receive radiation to the pelvis in therapeutic doses unless the pregnancy is to be interrupted. There is no intent in this presentation to detract in any way from this precautionary fiat.

DISCUSSION

Many of the statistical reports upon the damage sustained by the fetus are based upon unknown, indefinite, or unreported irradiation factors. Dosage has sometimes been classed as of "therapeutic intensity," indiscriminately including radiation from gamma rays as well as x-rays. Perhaps the most precise statement of cause and effect is contained in the reports of Harris and his associates, who were successful in causing fetal death and spontaneous abortion in 93 per cent of a large series. This contrasts sharply with the estimate of Jones and Neill of a fetal damage incidence of 20 per cent for cases in which the average dose was probably larger. The observations of the latter writers show a slightly wider latitude in respect to fetal age and also in respect to dose, size and location of the field of irradiation, and the rate of administration. In their cases, as in those of most observers, the fetus was only the accidental recipient of rays directed at a lesion in an adjacent organ, whereas Harris and Mayer carefully and intensively irradiated the entire gravid uterus. This comparison would tend to support the first hypothesis of Archangelsky, that the mechanism is a direct effect upon the fetus. Such effect is hardly comparable to ordinarily observed radiation damage, where cell necrosis is the important early manifestation, varying with respect to sensitivity of the cells exposed and with the dose.

In the fetus the effect is strangely selective for a resistant tissue, the central nervous system. There is general agreement that after the fifth fetal month serious damage is less likely to be incurred, permitting the conjecture that certain cells of the embryonic structure may at that time have attained a maturity making them less sensitive to radiation, or that such cells have accomplished their function and are no longer essential to further development of the central nervous system and related structures. It seems quite unlikely that the newborn infant would survive irradiation of the intensity and scope to which the fetus is sometimes subjected with no apparent effect.

The case here reported nearly conforms to the circumstances and irradiation factors required by Harris and Mayer for the accomplishment of spontaneous abortion. The primary radiation was given in smaller fractions over a period of two weeks instead of two days; the beam was directed not at the uterus but in such a manner that the fetus was necessarily included and actually received a larger total dose than that recommended for abortion. The fetal age was only slightly greater than that specified, radiation having been given during the nineteenth and twentieth weeks rather than prior to the eighteenth. No explanation is offered for the non-effectiveness of roentgen irradiation in this case; the result seems to be fortuitous. From a review of the literature it appears that a direct effect of radiation upon the fetus is an important part of the mechanism caus-

ing injury, but that the fetal age is a modifying factor.

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SUMARIO

Tolerancia Fetal a los Rayos X

Una mujer de 29 años recibió, durante su séptimo embarazo, la irradiación por lesiones metastáticas del sacro e ileon, secundarias a carcinoma mamario. Calculóse que recibió una dosis mesopelviana total de 1,275 r. La dosis para el feto excedió, pues, la recomendada por Harris y Mayer para producir aborto, aunque administrada en fracciones más pequeñas durante un período de tiempo más prolongado y a una edad fetal ligeramente menor que la estipulada por dichos autores, es decir, durante la 19a. y la 20a. semanas, más bien que antes de la 18a.

Por medio de la cesárea se extrajó a la paciente un feto varón que no revelaba defecto físico alguno. Se desarrolló el mismo normalmente y a la fecha de esta comunicación, ya próximo su cuarto cumpleaños, no mostraba el menor atributo anormal o extraño. No se ofrece explicación alguna de este desenlace inusitado.

Radiotherapy of Acne Vulgaris: Comparative Tests of Treatment Technics[1]

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THE PURPOSE OF the investigation to be described in this paper was to gather some experience in the use of an experimental design under clinical conditions. The design which was used is known as *factorial design*. It is applicable in situations where a result depends on several factors, the effects of which are roughly known, and where it is either impossible or inadvisable to keep all but one factor constant. Factorial design has been used mainly in agriculture; it has been introduced into diagnostic methods; but, so far as is known, it has not been employed in respect to therapy. Yet, it would seem to be very suitable for the evaluation of small differences in the success of competing therapeutic procedures.

The clinical test object was the radiotherapy of acne vulgaris. The selection was not made on grounds of inherent interest. The radiotherapy of acne is more than fifty years old, its technics have remained practically unchanged for some thirty years, and the latest significant discovery in this field (of the effect of unilateral irradiation) was made fifteen years ago. The reason for selecting acne was that the irradiation technics recommended in standard texts—all of them backed by considerable experience—cover a sizable range of conditions. It was thought that factorial design might make a test sufficiently sensitive to select the best out of several methods almost equally good.

The results were more interesting than had been expected: within the limits tested, the rhythm of irradiations was shown to be the decisive therapeutic factor, while dosage and quality of radiation have no significant influence. Furthermore, it was found that radiotherapy of acne can be accomplished with smaller doses and in less time than commonly used; besides, the relation between radiation factors and tissue responses is of some radiobiological interest. All this information was extracted from a material of 60 patients. Thus, in this instance at least, factorial design proved to be quite useful in clinical research.

FIRST TEST: DESIGN

Technics commonly used in the treatment of acne vulgaris vary considerably. Three radiation factors were selected for this study: quality of radiation, intervals between treatments, and doses.

Quality: Most authors agree that filtered or unfiltered radiation are equally effective, but some are definitely in favor of one or the other. It was decided to compare an unfiltered radiation (100 kv.) with a filtered one (120 kv. through 3 mm. Al). These two settings differ not only in quality, but also in dosage rate and penetration; therefore, a third was added: 100 kv., but at twice the original distance. This equalized the dosage rate and approximately equalized the penetration. Because of greater overlap of the fields, the doses had to be slightly reduced with this setting.

Intervals: Recommended intervals range from half a week to two weeks. It was decided to compare weekly and semiweekly treatments with an intermediate interval (1.4 times a week) added.

Doses: Single doses recommended range from 37 to 150 r, and total doses from 200 to 1,200 r. It was decided to arrange the test so as to use three weekly doses, namely, 60, 85, and 120 r. Our technic calls for irradiation with three overlapping fields. The actual skin doses are about 150 per cent of the air dose applied to each field.

As a basis for evaluating the efficiency of radiation factors, the total treatment time was selected. This time is the period between the first treatment and the point where further treatment is deemed to be unnecessary. This end-point is defined by

[1] From the Department of Radiology, Carle Hospital Clinic, and Physics Department, University of Illinois, Urbana, Ill. Accepted for publication in December 1948.

TABLE I: RADIATION FACTORS IN ACNE THERAPY: FIRST TEST

Patient No.	Radiation Factors										Clinical Data					Therapeutic Results		
	Treatments per week			Quality			Weekly dose (r)			Single dose (r)	Sex	Age	Duration of acne (yr.)	Grade (basis 4)	Date of first treatment	Weeks to dry skin	No. of treatments	Follow-up* (as of October 1948)
	1	1.4	2	Unfiltered 12″	Unfiltered 24″	Filtered	120	85	60									
1			x			x	x			60	F	23	9	1	11-11-46	1.8	4	No relapse for at least 7 mo.
2	x				x			x		85	F	19	6	2	10- 3-46	4.5	5	No relapse for at least 1 yr.
3		x		x					x	42	M	16	2	2	12- 5-46	2.0	3	No follow-up
4	x			x			x			120	F	27	10	2	10-17-47	3.5	4	Slight relapse after 3 mo., well since
5		x				x		x		60	F	23	2	2	10-17-47	2.2	5	Slight relapse after 4 wk., well since
6			x		x				x	30	M	18	6	3	10-17-46	2.0	6	Slight relapse after 2 wk., cured, no follow-up
7		x			x		x			85	M	22	6	2	9-10-47	2.5	4	Relapse after 5 mo., cured, not seen since
8			x	x				x		42	M	18	3	2	10-29-46	2.0	5	No follow-up
9	x					x			x	60	F	17	4	2	11-22-46	3.5	4	No follow-up
10			x	x			x			60	M	16	3	2	12- 7-46	2.2	5	No follow-up
11	x					x		x		85	F	16	5	2	8-25-47	3.0	4	Flare-up in 2 wk., again in 3 wk., not seen since
12		x			x				x	42	F	16	2	1	9-30-47	1.0	3	No relapse for at least 11 mo.
13	x				x		x			120	M	15	2	2	9-13-47	2.5	3	No follow-up
14		x		x				x		60	F	17	5	3	3-11-47	2.5	4	Relapse after 8 mo., slight relapse 4 mo. later
15			x			x			x	30	F	18	5	2	10-14-47	1.2	3	No follow-up
16		x				x	x			85	M	23	5	2	4- 3-47	2.0	4	Slight flare-up after 1 mo., not seen since
17			x		x			x		42	M	18	4	3	4-17-47	3.2	7	Relapse after 8 mo., 1 mo. later, again 5 mo. later
18	x			x					x	60	F	20	6	1	4-17-47	2.5	3	No relapse for at least 11 mo.
19			x		x		x			60	F	21	5	1	5-10-47	1.5	4	Slight relapse 6 wk., not seen since
20	x			x				x		85	M	30	15	3	5-13-47	6.5	7	Slight relapse 5 wk., again 2 mo., not seen since
21		x				x			x	42	F	24	6	2	8-27-47	1.5	3	Slight relapse 6 wk., again 4 mo., not seen since
22	x					x	x			120	F	18	2	3	6-24-47	2.5	3	No follow-up
23		x			x			x		60	M	15	1	2	7-19-47	2.5	3	Did not quite clear; treated with resorcin 6 mo. later
24			x	x					x	30	F	19	4	1	7-22-47	1.5	3	Slight relapse 6 mo.; well at least 6 mo. later
25		x		x			x			85	F	17	2	2	8-13-47	1.8	3	Relapse 2 wk., not seen since
26			x			x		x		42	F	21	1	1	8-21-47	1.2	3	No follow-up
27	x				x				x	60	F	19	3	3	8-21-47	2.5	3	No follow-up (moved away)

* Every patient was followed for 2 months and instructed to return whenever there was a flare-up. "No follow-up" indicates that the patient was not seen. Statements like "no relapse for at least 7 mo." or "well since" refer to the time patient was last seen (usually for reason other than acne).

a certain state of the skin: the skin is drier than normal; no new foci develop; the old foci appear dry and are more conspicuous than before because of slight pigmentation. Thus, our end-point of treatment is not the disappearance of acne. It is our impression that, once the skin reaches the state described, further developments are not greatly influenced by additional irradiations. While the end-point is fairly well defined, there may be, in any single case, some doubt as to whether or not another irradiation should be given. In order to eliminate any biassing of the results by this uncertainty, the decision to terminate a series of irradiation was, whenever possible, made by the dermatologist, who did not know how any given patient was being treated, rather than by the radiologist. The time required to change the skin from the initial (with active acne) to the desired state (with dry skin and no activity) was determined by interpolation between the last treatment and the day when it was decided that no more treatment be given.

Thus, an arrangement had to be made to test the influence of three radiation factors on the treatment time, each factor being represented at three different levels. This is a situation of a type not uncommon in investigations of therapeutic methods; it is also the type of problem for which the method of factorial design was developed.

The principle of factorial design is to investigate, in one course, the effects of all possible combinations of every level of every factor, and to evaluate all results together in a certain order (4, 6). In the present case, there are three factors, each represented at three levels, yielding a total of $3^3 = 27$ combinations. These settings are shown in Table I. One sees that each rhythm, *i.e.*, 1, 1.4, and 2 treatments per week, is represented nine times. Similarly, each quality and each weekly dose are tested nine times. Thus, each factor is tested on the basis of the total material of 27 cases. To get the same basis of comparison by means of successive tests (without factorial design), three times as many patients would have been needed.

The 9 cases which received identical treatment with respect to one factor differ completely in regard to the two other factors. For example, among the 9 cases which received one treatment a week, every one of the combinations of qualities and weekly doses is represented. The sample is thus homogeneous only with respect to the number of treatments per week. The three qualities tested appear in 3 cases each and in each of these three subclasses we find each of the three weekly doses. The same distribution of the other two factors is found in the cases treated 1.4 times and twice a week. The three samples distinguished by the different rhythms are thus perfectly symmetrical with respect to quality and weekly dose. The comparison of these samples is not less valid than if quality and weekly dose had been kept constant; it is, in fact, even more valid because it is based on a wider range of conditions. If there are any *interactions* between the factors tested, they can be demonstrated by comparing the averages of appropriately formed classes (4, 6). The possibility of finding such interactions is an additional asset of factorial design.

The patients contained in each class differ one from another in some ways which are predetermined by the design of the experiment; they also differ in regard to severity and duration of symptoms, in age, sex, etc. It is quite likely that some of these factors influence the therapeutic results as much or more than the planned variations in radiation technic.[2] One

[2] The author and two colleagues made guesses on the outcome of the experiment. The question submitted was: "The best technic of treatment, among those considered, will be that which yields the shortest treatment time; the poorest technic, that which gives the longest. Do you expect that the shortest treatment time will be at least 20 per cent shorter than the longest treatment time?" All three answered, "No." None foresaw that the shortest treatment time would be only half as long as the longest. All three have considerable experience in the radiotherapy of acne, all three are certified specialists (in dermatology, roentgenology, and therapeutic radiology, respectively). The failure of three experts to expect a very simple result makes one somewhat thoughtful about the foundations of some of our therapeutic habits.

could attempt to control the additional factors by symmetrical distribution; however, he could never be certain that he had recognized and controlled every significant factor. A consistent way of dealing with the whole complex of all factors except the planned ones is a procedure called *randomization*, the principle of which is to subject all but the planned factors to the free play of chance, thus making sure that any influence on the response has an equal chance to associate with any of the planned factor combinations. The extent to which uncontrolled factors influence the results can be measured by comparing responses to identical combinations of planned factors; the measure thus obtained is used as a yardstick for estimating the significance of the results obtained in the test.

One factor which might influence the outcome of any combination of radiation factors is the position of a case in the series. It was known that it would take some time to collect the series, and the acne response might show seasonal variations. Also, therapeutic judgment might change during the series. Therefore, the 27 treatment combinations were arranged in blocks of three cases each, each block containing every level of every factor; further, each sequence of three blocks contains all nine combinations of any two factors (see Table I). Arranging the treatments in this sequence assured an even distribution of all factors over the whole series.

In performing a randomization it is important not to take anything for granted, *i.e.*, not to interfere in any way with the free play of chance. The decision regarding the treatment to be used in any given case must not be subjected to the choice of either physician or patient.[3] Thus, the sequence in which the various treatment combinations were used was determined by actual drawing of lots, subject to the restrictions described in the foregoing paragraph. The patients were assigned to the successive treatment schemes in the sequence of their registration. If any patient either would not accept the proposed type of treatment, or failed to adhere to the schedule, he was given whatever treatment could be arranged but was excluded from the records of the test. In any case where a treatment scheme was not satisfactorily carried out, the test was repeated, until all parts of the experiment were completed. The 27 records which make up this test, plus the 14 which went into the second test, were collected in the course of treating 60 acne patients. Thus, almost one-third of the material could not be used for the test. A comparison of the number of a patient with the date when treatment started (Table I) will reveal the repeats. This loss of some material is characteristic for all complex designs: the more complex the design, the harder it is to have each case turn out as desired, and the more repetitions are needed.

[3] Statistically correct design can be used in therapeutic research only if the elimination of choice between alternatives is morally admissible, that is, whenever there is no good reason to believe (before the test) that one alternative method is better than the other. Carefully designed tests are indicated whenever slight differences in success are under investigation (and there are many such situations in radiotherapy). Where alternative methods show striking difference in success, no refined statistical procedure is needed.

FIRST TEST: RESULTS

Table I shows the therapeutic technics used in the 27 cases, together with clinical data and therapeutic results. The treatment times (weeks to dry skin) range from 1.0 to 6.5 weeks. The over-all average is 2.4 weeks.

Quality of Radiation: The average treatment time for all cases treated with filtered radiation (120 kv., 3.0 mm. Al) is 2.1 weeks; for all cases treated with 100 kv., unfiltered, at 12 inches T.S.D.F., it is 2.7 weeks. The third arrangement—unfiltered radiation, T.S.D. doubled to give the same r/min and penetration—gave an average treatment time of 2.5 weeks. These differences are slight compared to the variability of the results; differences of this magnitude could very well arise from random sampling.

Weekly Dose: With 120 r per week (*i.e.*, 120 r once a week, or 85 r 1.4 times a week,

or 60 r twice a week), the average treatment time is 2.3 weeks. With 85 r it is 3.1 weeks, and with 60 r it is 2.0 weeks. These differences are larger than those found with different qualities, and would occur by chance in only 1 per cent of similar tests.[4] However, the three figures show no trend, the longest treatment time having been obtained with the middle dose of 85 r per week. Thus we are inclined to believe that the amount of the weekly dose (within the limits tested) has no influence on the treatment time. Additional information, obtained in the second test, confirmed the independence of effect from dosage.

Rhythm (number of treatments per week): The average treatment time in all cases treated once a week is 3.4 weeks; for 1.4 treatments a week, 2.0 weeks; and for two treatments a week, 1.8 weeks. The differences here are larger than with the other factors, and the probability that they might have arisen by chance is less than 0.1 per cent.[4] Moreover, they show a definite trend, the treatment times being roughly proportional to the intervals between treatments. Dividing the averages by the intervals used, one obtains quotients of 3.4, 2.8, and 3.6, respectively, with a general average of 3.3. The deviations of these three averages from the general mean are small, and easily attributable to chance fluctuations. Thus, it seems that, within the range investigated, each treatment contributes the same amount toward the therapeutic goal regardless of whether the treatments are separated by 7, 5, or 3 to 4 days. This indicates that one should re-evaluate the results on the basis of number of treatments rather than of total treatment time.

The number of treatments varies from 3 to 7, with an average of 4.0. Broken down into the various classes, the averages are as follows:

Quality: Filtered, 3.7; unfiltered, 4.1; unfiltered at doubled distance, 4.2.

[4] The estimate of probabilities was arrived at by Fisher's z-test. An example of this test will be given at the end of this section.

TABLE II: ANALYSIS OF VARIANCE
(Number of Treatments a Week)

	Sum of Squared Deviations	Degrees of Freedom	Variance
Between classes	6.48	2	3.24
Within classes	31.52	24	1.31
Total	38.00	26	
			Z = 0.451

Weekly dose: 120 r, 3.8; 85 r, 4.8; 60 r, 3.4.

Treatments per week: 1, 4.0; 1.4, 3.6; 2, 4.4.

The class means are scattered around the general mean of 4.0. The significance of the deviations was tested with Fisher's z-test (3).

The scatter is measured by the *variance*, or mean squared deviation from the average. The total variance of all cases around the general average is analyzed into two additive components, the variance within classes and the variance between classes. Both components are used to estimate the variance of the population. Under the hypothesis that the population is homogeneous, *i.e.*, that the differences between classes are of no significance but due only to random sampling, the two estimates must yield the same result. Actually, there will be some discrepancy, which may or may not be significant. The significance of the discrepancy is determined by the z-test. One expresses the discrepancy in terms of "z," which is one-half the difference of the natural logarithms of the variances. The probability that a discrepancy as large or larger than "z" arises from random sampling depends on "z," on the number of classes, and on the size of the samples. Fisher has prepared tables which give distributions of "z" for probabilities of 5, 1, and 0.1 per cent (3). These are consulted to estimate the significance of experimental results.

Table II shows the analysis of variance and determination of "z" for the three rhythms used. The value of "z" is found to be 0.451. Fisher's table for the 5 per cent-point, for three families and a total

TABLE III: CLINICAL TEST NO. 2

Patient No.	Radiation Factors						Clinical Data				Therapeutic Results	
	Treatments per week			Single dose (r)			Sex	Age	Duration of acne (yr.)	Grade (basis 4)	Date of first treatment	No. of treatments	Follow-up (as of October 1948)
	2	3	6	30	20	10							
1			x	x			F	30	8	1	12- 5-47	4	Slight relapse, 2 wk.
2	x				x		F	25	2	2	11-18-47	3	Relapse after 1 mo.
3		x				x	F	19	3	3	12-16-47	4	No follow-up
4	x			x			F	33	20	1	11- 4-47	2	No follow-up
5		x			x		M	16	2	2	12-20-47	4	Slight relapse, 1 mo.
6			x			x	F	19	4	3	12-23-47	(6+)	Followed by 3 treatments with 30 r. Relapse after 2 wk.; 6 treatments needed
7		x		x			F	17	3	2	11- 8-47	3	Additional treatment for residual deep foci. Relapse after 1 mo. and again after 7 mo.
8			x		x		F	21	5	1	1- 5-48	3	Flare-up in 2 wk.
9	x					x	F	16	1	2	1- 7-48	(4+)	No improvement with 4 treatments
11	x				x		M	22	2	2	1-13-48	5	No follow-up
13	x			x			M	20	2	2	1-13-48	4	Slight relapse in 2 wk.; relapse in 8 mo.
14		x			x		F	18	1/2	2	1-19-48	(5+)	Followed by 2 treatments with 40 r
16		x		x			M	18	2	2	2-21-48	5	No follow-up

sample of 27 individuals, gives a value of 0.607. The discrepancy found is markedly smaller than that. Therefore, the chance is more than 5 per cent that it could have arisen from random sampling, and it is not considered significant. The differences between qualities are still smaller, and thus less significant. The analysis of the differences between weekly doses yields a "z" of 0.650, which is higher than the 5 per cent-point. Fisher's table gives a 1 per cent-point of 0.862. Thus, differences as large or larger than those found between weekly doses will occur by random sampling in between 1 per cent and 5 per cent of all cases. The evidence for a real difference is suggestive but not compelling. Additional information, obtained in the second test, indicates that the difference between weekly doses is not a real one.

The analysis given is based on the assumption that all interactions are negligible (4). This assumption is reasonable in the case under consideration, and may be accepted unless the opposite is proved. For rigorous deductions, the test would have to be repeated, entirely or in part. However, a confirmation can also be obtained by enlarging the range of conditions investigated, and this method seemed to be more profitable. Thus, a second test was designed, covering a region extending into the clinically most desirable field, namely, toward smaller doses and shorter intervals.

SECOND TEST

The first test had shown that about four irradiations will produce the desired effect in acne, and that the number of irradiations is the same for single doses from 30 to 120 r, and for intervals of from half a week to one week. A second test was designed to see whether the interval could be shortened and the dosage reduced still further without reducing the effectiveness of the treatment.

The first 9 cases in Table III show the arrangement of this second test. Single doses of 30, 20, and 10 r are combined with rhythms of 2, 3, and 6 treatments per week. Filtered radiation was used in each case,

not because of any preference, but because the lower dosage rate facilitated accurate dosage control.

Of the 3 cases treated with single doses of 10 r, only 1 (No. 3) showed the desired effect after 4 treatments; in 2 others (Nos. 6 and 9) the treatment was not satisfactory. Likewise, we did not feel sure about the advisability of 6 treatments a week. Thus, we did not repeat all nine combinations as planned, but only the four combinations with 30 and 20 r, and 2 and 3 treatments a week. In this series, we raised the dose in one case started with 20 r (No. 14), after 5 treatments had failed to achieve the desired effect.

Counting only the treatments finished with the starting dose, the average number of treatments in this series is 3.7, *i.e.*, about the same as in the first series. The average for single doses of 30 r is 3.6, for 20 r, 3.8; for treatments twice a week, 3.5, for treatments three times a week, 4.0.

Table IV gives a survey of the results obtained in both tests, arranged according to single doses and to rhythm. One sees that the number of treatments deviates little from the general average of 4.0 throughout all doses and intervals tested. The material is incomplete in the lowest doses and shortest intervals (the cases where the dose was raised during the treatment are omitted), and not all classes are completely represented: the combinations of the highest doses with the shortest intervals were omitted because of the danger of skin damage, and the lowest doses with the longest intervals, because of the danger of inefficient treatment. The results show that the number of treatments necessary to obtain a certain effect in acne is independent of dose and of intervals between irradiations over a considerable range; the exact boundaries of this range cannot be determined by clinical experimentation.

TABLE IV: NUMBER OF TREATMENTS VS. SINGLE DOSE AND INTERVALS

A. Dose

Single Dose	Average Number of Treatments	Number of Cases	Range of Treatments per Week
120	3.3	3	1
85	4.5	6	1–1.4
60	4.1	9	1–2
42	4.0	6	1.4–2
30	3.8	8	2–6
20	3.8	4	2–6

B. Rhythm

Treatments per Week	Average Number of Treatments	Number of Cases	Range of Doses Tested (r)
1	4.0	9	60–120
1.4	3.9	9	42–85
2	4.2	13	20–60
3	4.0	4	10–30
6	3.0	2	20–30

DISCUSSION

The indifference of the acne response to dosage could make one doubt the importance of radiation in comparison to the topical and general measures to which the patients are subjected. However, the distinctive connection between treatment time and rhythm makes it clear that irradiation is really the leading factor in inactivating the acne process. The dose of rays can be quite small: 30 r is just as effective as 120, and 20 and 10 r are effective in some cases. In the light of these findings, it seems appropriate to reconsider the significance of the effect of unilateral irradiation in acne. Niles, Polano, and Kline and Gahan (7) subjected acne patients to unilateral irradiation, and found that in about two-thirds of the cases the response was equally good on the unirradiated side. One has to realize that the "unirradiated" side does receive some dosage—of the order of 1 r—and that such a small dose might be effective.

For clinical purposes, one will select the smallest dose and the shortest interval for which the irradiations are still fully effective. We have been using 25 r (or about 37 r skin dose) three times a week, since the two tests were completed. The results have been consistently the same: about 4 treatments are needed to deal with the common forms of acne.

At the end of the treatment, the patient is emphatically warned that recurrences are very likely, and that he should return for further treatments whenever any

eruptions persist for more than three days, or when the skin becomes oily. We believe, therefore, that we see a good part of such relapses as occur. We find these more frequently than most other authors. It is our impression that this greater frequency is apparent rather than real. When we treated acne with weekly doses, for periods of several weeks, we often observed exacerbations during the period of treatment. With our greatly shortened treatment time, an exacerbation occurring at the same time would be classified as a relapse, because radiotherapy was declared finished at the time it occurred. However, even including treatments given for recurrence, our total treatment number is still small. In Tables I and II, all relapses which came to our attention are entered. Cases marked "slight relapse" or "flare-up" needed 1 or 2 treatments in the second series; in the cases marked "relapse" the second series required as many treatments as the first one—4 on the average. Summing up all primary and subsequent series, we obtain an average of 5.8 treatments per patient.

The mechanism of radiotherapy in acne is not exactly known. Clinically, one notices cessation of inflammation and inhibition of sebaceous secretion. The elaboration of sebum depends on continuous production of new cells and on their transformation into secretion. Either process could be temporarily inhibited by very small doses.

Whatever the mechanism of the radiation response in acne may be, it has some features which (in their combination) are not quite matched by any other clinical or radiobiological experience.

Divided doses are, in our experience, more effective than single doses. Four times 25 r (a total of 100 r), delivered at suitable intervals, produce a greater effect than 120 r in one sitting, or even two times 120 r. Similar effects are known to occur in actively growing tissues. An irradiation will cause temporary inhibition of mitosis, followed by a short period of abnormally high mitotic activity. If a second treatment falls into the period of inhibition, it is ineffective, but if it is timed so as to fall into the period of increased mitotic activity, the total effect of the two treatments is greater than the effect of the combined dose delivered in one sitting (5). Reisner (10) found that irradiation delivered during a height of reaction to a previous treatment has enhanced erythema-producing power. None of these cases are quite comparable with the one here reported; they depend on accurate timing of the subsequent irradiations, whereas, in our case, a considerable latitude of intervals has been found.

The acne response is independent of dosage over a considerable range. About 4 treatments will produce the desired effect, whether the dose is 25 r or 120 r; the response is *stable*. This stability of response is limited to a certain dosage range: at about 10 r, the response becomes weaker; on the other hand, there must be a dose where it grows stronger, because a single treatment with a very high dose will prove effective (but is dangerous to the skin). Several situations where responses have stable values over significant ranges of doses are known. Several stable values were found in an investigation of radiation-induced stunting in plants (9), and two stable values were identified in a study of survival times of mice after total body irradiation (8). In clinical experience, the stability of the erythema reaction over considerable dosage ranges has been pointed out by Widmann (11); in this case, the dosage range correlated with the stable response depends on the field size. In all these cases, the responses are stable at values which are neither obvious minimum nor maximum responses, that is, at values where stability is not expected. In no case has it as yet been possible to determine why a particular response is stable.

The acne response is stable not only with respect to dosage, but also with respect to intervals between treatments over some range of intervals. This range must have a lower boundary; a single dose of

120 r, which is equivalent to four times 30 r delivered with zero intervals, is less effective than four times 30 r at two-day intervals. The lower boundary might be in the neighborhood of one day. The upper boundary must be higher than one week, for doses down to 60 r; that it exists is implicit in the frequent return of the skin to its pre-irradiation condition. Thus, stability of response over a certain interval has been ascertained, but the boundaries of this interval could not be accurately located because of inherent restrictions in clinical experimentation. This situation suggests that only the first 20 r or so of an irradiation are effective, and that a period of about a day has to pass before sensitivity to further radiation is restored. One conceivable mechanism which would fit such a scheme is the inhibition of mitosis.

Stability of response over a certain range of intervals has been found repeatedly in investigations of another split-dose effect, *i.e.*, reduction of the total effect by partial or complete recovery from the radiation insult. One such case has been found by Chase in his investigation of the controlled graying response of mouse hair (1, 2). A split-dose effect occurs here: the graying response to two doses, delivered at an interval, is significantly lower than that following administration of the combined doses in a single sitting. However, the response is independent of the length of the interval over a considerable range, namely, from several hours to several days. Thus in this case, the results of split-dose experiments suggest that a partial recovery occurs, but the stability of response with respect to intervals restricts the time during which this recovery process can take place. It seems that a somewhat similar situation exists in erythema reaction of the human skin. Here, too, there is a split-dose effect which (according to Reisner, 10) becomes manifest after four hours and is almost fully developed in twenty-four hours: the response to two doses is stable for intervals of from zero to four hours, and from one to several days. This, again, defines an interval during which the process responsible for the split-dose effect takes place.

SUMMARY

1. Technics recommended for the radiotherapy of acne vulgaris differ as to quality of radiation, dosage, and intervals between treatments.

2. Factorial design was used to arrange a test which permitted simultaneous comparison of the effects of various radiation factors.

3. It was found that the desired therapeutic effect is obtained with about four treatments, regardless of quality, dosage, and interval, within the limits tested.

4. Acne therapy can be done with smaller doses and shorter intervals than commonly used.

5. A characteristic radiobiologic feature of the acne response—stability with respect to dosage and interval—is discussed.

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SUMARIO

Radioterapia del Acné Vulgar. Pruebas Comparadas de las Técnicas Terapéuticas

Las técnicas recomendadas para la radioterapia del acné vulgar discrepan en cuanto a la calidad de la irradiación por emplear, la dosis y los plazos entre tratamientos. A fin de comprobar los efectos de esos varios factores de la irradiación, utilizóse el *diseño factorial*, procedimiento este aplicable a los problemas en los que resulta imposible o inconveniente mantener más de un factor constante.

Descubrióse que se obtenía el deseado resultado terapéutico con unos cuatro tratamientos, independiente de calidad, dosis y plazos, dentro de los límites ensayados, y que puede hacerse el tratamiento con dosis más pequeñas y plazos más breves que los empleados habitualmente. Desde que terminaron la pruebas, el A. ha empleado 25 r (unos 37 r de dosis piel) tres veces semanales, y los resultados han sido constantes, necesitándose unos cuatro tratamientos para las formas corrientes del acné.

Discútese una característica radiobiológica de la respuesta en el acné: la estabilidad con respecto a dosis y plazos.

Tentative Dose Units for Mixed Radiations[1]

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THE ORIGINAL definition of the roentgen (1928) applied to x-radiation only. It was a definition of a specific measuring system, not of a fundamental unit. The development of logical systems of gamma-ray dosimetry and of the use of higher voltage x-radiation in the early 1930's made the definition inadequate, although it was obvious that the same concept, interpreted as a tissue dose, could be applied directly to radiation treatments. There was a period of confusion in which some authors confidently expressed gamma-ray dosage in roentgens, while others denied such application. This persisted until 1937, when the modified definition of the roentgen, based on the Bragg-Gray cavity principle of dosimetry, was adopted. By that time it was realized that a statement of tissue dose based on a measurement of ionization arising in a suitable tissue-wall chamber was desirable. The practical difficulties of operating such a chamber were well known and accounted for compromise suggestions such as that of L. H. Gray, in which a chamber wall of a pure, universally available material such as graphite was proposed. A further compromise to consider air as the wall material around an air cavity was incorporated in the revised definition. This had the advantage of leaving the open air chamber, at least within a restricted range of radiation energy, as one suitable realization of a measuring system under the new system. With this device, no numerical changes were needed in the existing applications of dose in roentgens.

The extension of radiation choice beyond that common in 1937 has again made the roentgen, as defined, inadequate for required purposes. At the present time, dosimetry in roentgens either has to be supplanted, or supplemented, by the definition of other special units useful in radiology, radiological physics, radiobiology, and allied arts, but not required in general physics. There appears at present to be a general desire to return to a fundamental unit in the science of radiation dosimetry, which shall be independent of a specific measuring system. It would also disregard the fact that it may be possible at this time to measure such doses in an academically absolute manner. This is a less serious objection than is sometimes realized, because all existing dosimetry in roentgens is founded on the concept of instrumentation which approximates closely enough to ideal limiting definitions, and has no absolute status in science. Four feasible units have been suggested, and used by various authors:

(1) Energy absorption per unit mass (ergs per gram).
(2) Energy absorption per unit volume (ergs per cubic centimeter).
(3) Ionization per unit mass (ion pairs per gram).
(4) Ionization per unit volume (ion pairs per cubic centimeter).

PHYSICAL DOSE UNIT

The choice between the energy absorption system and the ionization system depends on whether the effect of ionizing radiation on biological materials stems entirely from the ionization produced in the material or whether it is significantly affected by that energy absorption which is dissipated in other forms such as molecular dissociation, kinetic energy of non-ionizing recoils, etc. The partition of the total

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energy absorption between ionization and other modes is not constant in all cases, but is believed to be approximately so in most applications of practical interest. Although the ionization system may prove eventually to be closer to the fundamental entity, there is a wider acceptance of an energy absorption basis. While there is doubt about the role played by energy absorption, other than the ionization quota, it is safer to accept the total energy absorption basis. In laboratory practice, many of the statements of either one will depend on a physical determination of the other.

The distinction between a unit-volume basis and a unit-mass basis is less important. The former would follow Gray's *principle of equivalence* more directly, and may be more attractive for statements of dose in bone, for example. However, the unit-mass basis has lately been more generally favored. As an acceptable compromise, it is proposed to use as the basic tissue-dose unit the energy absorption stated in ergs per gram. Laboratory experiments involving radiation dose would be universally reported in these terms, which would be understood, without ambiguity, by scientists in all fields. This "cold" unit would not be well received by practising radiologists or radiobiologists, and it would not readily integrate with their years of experience in the expression of dose in roentgens. It would be certainly unnecessary, and probably unwise, to attempt to eliminate the roentgen from usage in practical radiology.

Despite the increasing application of forms of radiation which cannot be measured in terms of roentgens, it will remain true that the majority of radiologists will confine their interests to problems in which dose can be properly stated in terms of the roentgen as now defined. For this reason, it is deemed advisable to agree at an early date on a *practical* energy absorption dose unit which would correlate with prior experience in dose measurement expressed in roentgens. Many such units have appeared in the literature, as, for example, tissue roentgen, nominal roentgen, equivalent roentgen (e.r.), rhegma, roentgen equivalent, roentgen equivalent physical (rep), gram roentgen, Gray's energy unit, and so on. These hinge on one or other of two known energy absorption relationships:

(1) One roentgen of x-radiation or gamma radiation corresponds to the absorption of about 83.8 ergs per gram of air. To a relatively poor approximation, this will correspond with the absorption of 83.8 ergs per gram of wet tissue, although the actual range is known to extend from 40 to 100 ergs per gram for x-radiation in the range of 12 to 800 kv. The *gram roentgen* and the original *rep* were based on this factor.

(2) One roentgen of hard gamma radiation corresponds to the absorption of about 93 ergs per gram in pure water. This is the basis of Gray's *energy unit.*

The second figure appears to be more generally acceptable as a transitional step for translating past experience with x-ray and gamma-ray dosimetry into the more generalized dosimetry with any ionizing radiation. For practical use, an easily written and pronounceable name, perferably one beginning with "r" (as in roentgen), and forming simple, multiple, and submultiple units is most desirable.

The writer recommends, as a compromise, the adoption of a practical energy absorption dose unit called the *rep*, and defined so that "one *rep* represents an energy absorption dose in irradiated tissue of (exactly) 93 ergs per gram." The particular term *rep* has been widely used within the Manhattan Project, since 1943, and it has spread from Atomic Energy Commission installations to many of the principal centers of radiobiological research. The basis has variously been 83 ergs per gram, 83 ergs per cubic centimeter, and 93 ergs per gram, and this can cause confusion in future interpretation of data. For this reason, it is strongly recommended that authors electing to use the *rep* should

include a footnote stating "1 *rep* = 93 ergs/gm.," or whatever form is used. The arguments for persisting with *rep* are: (1) Very little radiobiological work to date is accurate enough to make results sensitive to the difference between 83 and 93. (2) If there is any advantage in a unit beginning with the letter "*r*", selection of a new name now limits the final rational choice. (3) Such final rational choice should come by international agreement, with a more precise definition than that given above.

MANAGEMENT OF MIXED RADIATION EXPOSURES

One factor of the effective radiation dose of each component of a mixed exposure (*e.g.*, fast neutrons, slow neutrons, and gamma rays from a cyclotron or nuclear reactor) is defined by the statement of ergs/gm., or the practical derivative *rep*, for each radiation type separately. The combined effect is a function of other variables, some of which are (1) specific ionization of each radiation, (2) dose-rate of each radiation, (3) protraction and fractionation of each type, and (4) clinical circumstances such as condition of adjacent tissue. Under certain simplifying conditions, these can be reduced to a single factor, the familiar relative biological effectiveness (RBE) for each radiation type.

Two such limiting cases exist: (*a*) single acute exposure to mixed radiations; (*b*) chronic exposure to very small doses, daily or perhaps weekly, of mixed radiations. These are the only cases in which one can currently develop a plausible permissible exposure. Obviously, the first is of interest in atomic bomb attack, and the second in the everyday management of exposures in atomic energy installations.

To manipulate dose problems in the latter case especially, it was necessary to formulate an additional "unit," better described as a shorthand system than a formal unit at this time. Such a unit is the *rem*, where "one *rem* is that dose of any ionizing radiation which produces a *relevant* biological effect equal to that produced by one roentgen of high-voltage x-radiation, other exposure conditions being equal."

It is convenient to write down a *scale of relation*, which for chronic exposure is:

X-rays, gamma rays 1 r	≐	1 *rep*	= 1 *rem*
Beta rays		1 *rep*	= 1 *rem*
Protons		1 *rep*	= 10 *rem*
Fast neutrons		1 *rep*	= 10 *rem*
Slow neutrons		1 *rep*	= 5 *rem*
Alpha rays		1 *rep*	= 20 *rem*

The approximate equivalence of the roentgen and *rep* has been discussed already. In the transition to *rem*, the writer has previously specified high-voltage radiation as "about 400 kv." This removes the base from the region in which the photoelectric effect gives significant contribution. The selection of gamma rays from radium in equilibrium with its products would be equally suitable. In effect, the relative biological effectiveness of "ordinary" x-rays to radium gamma rays is taken as unity, instead of the conventional 1.4. This is an example of the inaccuracies of the present system which can be controlled in radiation protection work by safety margins, but would be intolerable in therapy. In the scale of relation, fast neutrons are taken as those which produce their biological effect by generation of knock-on protons in tissue. Slow neutrons are those which produce their effect by nuclear reactions, such as capture gamma rays from hydrogen and neutron-proton reaction on nitrogen. Omitted is a range of intermediate-energy neutrons, for which no quantitative dosimetry currently exists.

Application of the scale of relation is as follows:

1. Decide on the *relevant* biological effect or the significant organ of exposure. For penetrating external radiation, this will normally be the damage to the blood-forming organs. For predominantly soft radiation, it may be damage to the skin. Internal emitters may focus the effect on a specific organ, such as the thyroid gland for radioiodine or astatine.

2. Evaluate the separate doses to the significant organ in *rep*.

3. Convert each dose to *rem* by the scale of relation.

4. Add the total dose in *rem*, and compare with the accepted standard. Thus, if the permissible whole body exposure to hard x-rays is 0.3 roentgen per week, this means, approximately, that the permissible exposure to the blood-forming organs (the assumed significant organ) is also about 0.3 *rep* per week. The related permissible exposure is 0.3 *rem* per week, and to this figure the above-determined personnel exposures are compared.

For single acute exposures, the accident cases, an entirely different scale of relation and a different permissible exposure are needed. Also, in either case, the significant organ may change depending on the predominant components of the mixed radiation. The skin is a logical significant organ if soft external radiation predominates, and the lung irradiation controls if the principal exposure comes from the inhalation of insoluble radioactive materials. For this reason, conservative radiation protection requires the evaluation of the combined dose in *rem* for each of the feasible significant organs. In many practical cases, most of the "significant organs" can be eliminated by inspection of the nature of the exposure. The major weakness of mixed exposure management has been the failure to add the various contributions in some notation equivalent to the *rem;* the permissible exposures to various irradiating agents are published separately, and there is a tendency in less conservative groups to accept close to the limit of each type, with a resulting combined exposure that may be intolerable.

Therapeutic applications of mixed radiations can in principle be controlled by a statement of dose in *rem*, where the exposure conditions are reasonably repetitive. At the present time, no profitable application is known to the writer. Much greater precision in physical dosimetry in *rep* (or directly in ergs/gm.), rather than in roentgens, is needed before the further extension to the biological equivalence unit should be attempted.

NOTE ON NOMENCLATURE

The *rep* is an abbreviation of roentgen equivalent physical. The *rem* is an abbreviation of roentgen equivalent man or mammal. The more obvious choice of *reb* (roentgen equivalent biological) is avoided because of the confusion in speech between *rep* and *reb*. Both *rep* and *rem* should be used as words, not as three spoken initials. The convenient submultiples are written as *mrep* and *mrem*, and pronounced "millirep" or "millirem." Multiples such as *kilorep* and *megarep* are permissible, but the abbreviated forms should be avoided.

SUMMARY

Energy absorption dose in irradiated tissue should be stated in ergs per gram in scientific reports. In therapeutic and other practical applications, a practical unit, the *rep*, an energy absorption dose of 93 ergs per gram, allows a reasonable transition from previous experience in dose statements in roentgens. Under simplifying conditions, the combined effect of mixed radiations can be evaluated in a common unit, the *rem*. This method incorporates a factor for relative biological effectiveness in the physical statement of dose in *rep* of each radiation type. Such a device is necessary in the management of exposures of personnel to mixed radiations. It may be useful ultimately in mixed radiation therapy, when the physical dose is more precisely stated and knowledge of biological effectiveness factors is improved.

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SUMARIO

Unidades para Dosis Tentativas en las Radiaciones Mixtas

En las memorias científicas, la dosis de absorción de energía en el tejido irradiado debe expresarse en ergs por gramo. En las aplicaciones terapéuticas y otras de orden práctico, una unidad práctica, el *rep*, dosis de absorción de energía de 93 ergs por gramo, permite una transición bastante lógica de la costumbre anterior de expresar la dosis en roentgens. Simplificando aun más, el efecto combinado de las radiaciones mixtas, puede valuarse en una unidad común a todas, el *rem*. Este método agrega un factor referente a la efectividad biológica relativa, a la expresión física de la dosis en *reps* de cada forma de irradiación. Una fórmula de ese género resulta necesaria en la consideración de las exposiciones del personal a radiaciones mezcladas. También puede con el tiempo resultar útil en la radioterapia mixta, al expresar con mayor precisión la dosis física y acrecentarse nuestros conocimientos de la efectividad biológica.

DISCUSSION

R. R. Newell, M.D. (San Francisco, Calif.): We liked the roentgen, precise to measure and correlating well with effect on the patient. We measured exposure (radiation streaming in) and thought dose (quantity absorbed per unit volume). We hear the British workers think of roentgens as measuring dose, too. We have been thinking about the submission of tissues to radiation, with our attention not on the radiation but on its physical absorption.

Now, when we have to deal with much higher energies—betatrons at 20 to 100 megavolts, etc.—we find it no longer easy to measure exposure and be sure what we are doing. The corpuscular secondaries don't come into equilibrium with the x-ray beam until it's inside the patient. Would we originally have accepted a unit of exposure, instead of a unit of tissue absorption, except that the latter was difficult to measure and the former easy? Now that we enter a realm where exposure isn't easy to measure, should we not reconsider and turn, in fact, toward a unit of dose in terms of energy absorbed per gram of flesh?

Mr. Parker points out that energy per gram still isn't exactly what one desires—not roentgen equivalent physical, but roentgen equivalent biological (*rem*) is the critical measure. Dr. Stone would like to bring it down to microscopic or submicroscopic pattern—energy absorbed per microgram, or per gene, or per molecule. But if you refine it to the last notch, you end up with a mere tautology: the dose I gave (no matter how I measured it) was calculated to produce such and such an effect in the particular patient (animal, plant) I was dealing with. No unifying concept is left. We can have a unit which applies to all irradiated objects but correlates unevenly with the effects produced. Or we can have a unit which correlates well with the effect produced but is applicable to a very narrow class of objects. But apparently we can't have both broad coverage and close correlation over the extraordinary range of radiations available today.

Mr. Parker (*closing*): Dr. Newell makes a good point in reminding us that radiologists are concerned with what occurs locally at some particular part of tissue. Of course they are. That doesn't stop the use of an energy absorption unit in ergs per gram. We don't have to weigh out one particular gram of tissue and by some method, probably wrong, find out how many ergs were absorbed in that particular gram. Dr. Stone mentioned the micro-microgram. That is all right. You determine, if you can, the number of ergs that were absorbed in the particular piece of tissue which you are interested in. We have to be a little careful on this. I think some radiologists figure that you give one roentgen to a cubic centimeter of tissue, and if you happen to have started with half a cubic centimeter of tissue, all things being equal, you have given that half a roentgen. Let's get away from that concept, please.

I would like, also, to put into this a plug for compromising these units. The important thing is that we agree as quickly as possible on some energy absorption unit. We lost years of dosimetry skills by haggling from 1930 to 1937 on what we had better do. This time we can see we have the same kind of problem. Let us work out of it, and take something which will be reasonable for the next ten years.

Fortunately, I can assure Dr. Muller, we don't have to worry about the genetic death of radiation units. If this unit is dead ten years from now, that will mean we have made significant advances in dosimetry. If it helps us out for ten years, it will be extremely useful, more so than if we just go on haggling. Let us not say that each man has his name somewhere in the literature on a particular

unit and let him plug for that. This *rep* is "roentgen equivalent physical," not "Roentgen Equivalent Parker." I have nothing to do with it except that during the war, at Dr. Stone's request, we came up with some practical units in which we could get on with a particular job, which I think Dr. Stone did exceptionally well. The particular titles that came out of Dr. Stone's request were *rep* and *rem*. It would be a good thing if somebody could come up with a convenient title, something beginning with r and not mixed up in speech with other things, something useful and not too long. That is really what we need. Any other title is absolutely all right.

In regard to Dr. Newell's point, there is this difference in thinking between the British and American schools. It is exposure *versus* dose, which is to say the British switched to the tissue dose concept many, many years before that seemed to be acceptable here. Academically, it is bad to make a definition which says one thing and use it another way. If that other way is fundamentally right and makes basic sense and gives you better dosimetry, let us put the academic people in the background and go ahead with it, and do the same with an energy absorption unit.

As to the question of trying to get one unit or *rem* which will answer all biological questions in one easy lesson, that is impossible. The physicist is not that smart. That would mean you could write the whole subject of experimental radiobiology in one sentence. This, I am sure, is wrong. Otherwise, some brilliant men are misspending a lifetime.

The Tumor Clinic as a Study Group[1]

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THE SIZE AND scope of a tumor clinic are largely determined by the measure of financial support which it enjoys. Where funds are available in sufficient amount, a wide field of activity may be encompassed. This will include all or most of the following—diagnosis, hospitalization, treatment, research, and teaching. It must be obvious that only a few private organizations can provide or obtain the necessary means to carry out a fully comprehensive project; hence the larger and more complete tumor clinics are usually government agencies.

Such institutions are not the concern of this paper, which will be devoted rather to a consideration of the field available to smaller tumor clinics with limited or negligible financial backing and the necessary organization under such circumstances.

Because of financial limitations a small tumor clinic cannot include surgical or radiation treatment. Similarly no diagnostic procedures beyond ordinary physical examination can be afforded. One might imagine our tumor clinic, shorn of sovereignty in these important phases, to be practically a nonentity. It will be my purpose to show that with proper organization such a conclusion is not valid. I offer as the basis of my contention the old adage that "talk is cheap." By this I mean that we can still have a flourishing tumor clinic which confines itself mainly to the discussion and observation of cases of malignant disease despite the fact that it does not personally handle them. Our small tumor clinic thus emerges as essentially a discussion group. Education of the profession for the benefit of the patient is the function of such a tumor clinic.

Having thus realized the scope of our clinic, the problem of organization resolves itself into one of providing tumor material for discussion. Our success will depend on how well this work is done.

Although the clinic's main activity is discussion, it has nevertheless one physical responsibility. That is the keeping of a record of discussions and the following up of patients who have appeared before it. Some expense is unavoidable in this connection.

The tumor clinic to be described in this paper, as an example of what we consider adequate organization, is associated with a 500-bed general hospital. Apart from the loan of a nurse and stenographer for a few hours a week and the help of a junior intern, the personnel is entirely voluntary. About 100 beds are available for teaching purposes under the honorary attending staff; the remaining 400 are used by the open staff.

The tumor clinic is composed of all those who care to attend the weekly meeting held at 11 A.M. on Fridays. The only appointed members are the chairman and secretary. The chairman's duties are to conduct the meeting and he is selected for his ability to lead the discussion. The secretary is responsible for arranging the agenda of the meetings and supervising the record-keeping.

Since the tumor clinic has no patients of its own, it must borrow or obtain material from other sources. From experience, it has been found that many doctors do not remember to refer their patients. It has also been found that general appeals for such referrals are soon forgotten. A systematic method was therefore set up to provide a supply of cases. The entire

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[1] Read by title at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.

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hospital is surveyed every Tuesday and a list of all tumor cases compiled. This is done by an intern. It has been found most satisfactory to have him glance at each chart himself rather than merely ask the ward supervisors. The whole survey never takes over two hours.

On Wednesday the secretary goes over the list. New cases of malignant disease on the teaching wards are automatically slated for presentation and the staff man is advised. If there are interesting private cases on the list, the doctors in charge are invited to present them. In the majority of instances the invitation is eagerly accepted. Frequently doctors with interesting cases or problems will ask to present them for the consideration of the clinic. As the number of indigent cases has decreased during the past few years of economic prosperity, an increasing proportion of private patients have been presented.

On Thursday the intern summarizes the data of the cases selected for presentation at the Friday meeting. He also makes a list of the patients' names and wards and indicates whether the patient is to be brought to the meeting or not, and what, in the way of roentgenograms, charts, or pathological specimens, will be required. This list is picked up by one of the Out-Patient Department nurses, who assembles all that is required on Friday morning.

In addition to cases from the hospital wards, other patients come from outside for follow-up. The handling of these will be described later.

All these preparations culminate in the regular weekly meeting of the tumor clinic in the hospital auditorium. An electric sign at the hospital entrance reminds the doctors of the meeting and the agenda is posted in the doctors' cloakroom. The meeting is open to all doctors and interns. Provision has been made in the teaching schedule for undergraduate medical students to sit in as well. However, as time is at a premium, no attempt is made to explain fundamentals for their benefit, and discussion is conducted at the graduate level.

The case history is first presented to the group, the patient is then seen and examined by a few members, and roentgenographic or other data are presented. This is followed by a discussion of all aspects of the case. For each patient a conclusion and recommendation are made and a date is set for review of the case. The proceedings of the meetings are taken down by the stenographer. This record is combined with the case summary and constitutes the tumor clinic record.

It should be emphasized here that the clinic has no executive authority. It is free to discuss the cases presented and make any suggestions or recommendations it wishes regarding diagnosis and treatment. Whether these are carried out or not is at the discretion of the attending doctor, be he staff or private. Since his is the final responsibility, it is reasonable that he should have the final decision.

Once a patient has been presented, the tumor clinic assumes a certain responsibility for following his progress if it is to fulfill properly its function as a teaching organization. For it is only by follow-up that we may evaluate the handling of the case and thereby add to our knowledge and experience.

At the initial and each subsequent visit to the clinic, a review date for each case is always set. A simple "reminder" card index file has been set up which brings the patient's name to the secretary's attention a week prior to this date. A letter is then sent to the patient asking him to return. The mechanism of the system is quite simple. The card for each case has twelve divisions along the top corresponding to the months. A small paper clip in the appropriate monthly division clearly indicates when each patient is due to return. It is a relatively routine matter to get indigent patients back for review. Private patients require somewhat different handling. It is customary to ask the doctor concerned in private cases if he is willing to have the clinic follow the case. Many doctors greatly appreciate this service. The letters to private patients ask them to

return only if they have not recently seen their own doctor. In some cases the doctor supplies the follow-up notes.

When returning for follow-up, the patient presents himself at 10 A.M. and is examined by the intern, who writes a short note regarding his observations. This is presented to the clinic along with the patient. If necessary, there is further examination at the meeting by the "experts." If more elaborate investigation seems indicated, this suggestion is sent to the doctor in private cases, while the indigent patient is sent to the appropriate Out- or In-patient service and a review date is set. If the patient's condition seems satisfactory, only a review date is set. In each case a definite conclusion or recommendation is made and recorded. The entire discussion at each visit is incorporated in the patient's record along with any developments that occur between visits.

The expenses of the "follow-up," record keeping, etc., are borne by the hospital, which donates the stenographic and nurse service, stationery, and postage. The stenographic duties correspond to about one working day per week. The nurse spends about three hours a week on tumor clinic work Friday morning. The hospital also co-operates in allowing the clinic the use of the auditorium for its meetings. Much credit must be given the junior intern associated with the tumor clinic. He is on a combined x-ray-pathology service for a month and does much of the "leg" work. Human nature being what it is, the interns show varying degrees of enthusiasm. Some of them require a bit of encouragement.

To what extent has the tumor clinic succeeded in its role as an educator? It is difficult to assess this quantitatively. But week by week the cases seen and the lessons learned make a deeper and deeper impression in our memories and thereby broaden our experience. From time to time we review our material and present symposia on various phases of cancer at the bimonthly clinical luncheons. These are subsequently published in the local medical journal. Thus, on a very limited budget augmented by a bit of personal effort, our tumor clinic occupies an important place in the education of the medical profession in cancer consciousness. It is now an accepted principle that this is a prerequisite for the success of any educational program directed to the public. I submit therefore that a proportion of any funds earmarked for cancer education be applied to the fostering of tumor clinics of the type outlined above.

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SUMARIO

La Clínica de Tumores como Grupo de Estudio

Quedan aquí expuestas las posibilidades que ofrece una clínica de tumores, sin medios de tratamiento o diagnóstico, aparte del mero examen físico, y dedicada a la discusión y observación de casos de enfermedad maligna. La clínica, descrita como ejemplo de organización adecuada para el fin mencionado, se halla asociada con un hospital de 500 camas. El personal de la misma, excepción hecha de los servicios de una enfermera y taquígrafa por algunas horas cada semana y de la ayuda de un interno principiante, es absolutamente voluntario.

The Medicolegal Implications and Status of Fluoroscopy[1]

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FLUOROSCOPY is apparently becoming of great medicolegal importance because of the augmentation of the number in the field of radiology, through the entrance into this specialty of many physicians who made use of the fluoroscope in the Army and Navy during the Second World War.

As an old timer in this field of medicine, I consider it both my duty and privilege to warn my younger colleagues against the indiscriminate use of fluoroscopy in civil practice. During the past few months, I have seen several cases of roentgen dermatitis following and unquestionably due to fluoroscopy, all the result of overexposure and all produced by recently returned veterans who had had little experience with x-rays before their induction into the Armed Services.

Because of the limitations of fluoroscopy and the dangers incident to its careless use, its medicolegal status demands careful consideration. With the present methods, perfected apparatus, and advanced knowledge of the effects of the roentgen rays, there is little or no excuse for accidental overdosage during a series of fluoroscopic or film examinations sufficient for complete study of the human body. No qualified radiologist will deny that such examinations may be made with safety if the operator knows his apparatus and technic.

That every physician, when he enters the practice of medicine, shall possess an ordinary and reasonable degree of knowledge and skill, and apply that knowledge and skill with ordinary care and diligence, is the rightful expectation of the public, and the courts of our country have learned to demand this. Physicians in smaller towns and cities, away from the larger centers of population and medical education, are not expected to possess and exercise as high a degree of knowledge and skill as specialists from the large cities or centers of medical education. Indeed, it is pretty well established that the degree of knowledge and skill which practitioners of medicine are required by law to possess and apply is that degree of knowledge and skill ordinarily possessed and applied by members of their profession *in the same line of practice, in the same or similar locations and at the same time.*

While we as physicians are not expected to be guarantors of results from our ministrations, we do guarantee that we possess the ordinary degree of knowledge and skill and that we will exercise ordinary care and diligence in the application of that knowledge and skill as applied under similar circumstances and conditions in the same or similar localities. *But, it should be indelibly impressed upon us* that, while knowledge and skill may vary somewhat in different geographical localities, *the amount of radiation which may properly and safely be applied does not vary with the locality.* In other words, the radiation which may be applied to the human body, particularly in and during a diagnostic procedure, is so nearly a fixed and measurable amount, that the radiologist using and applying the same should be cognizant of the proper dosage and not exceed it, whether he is practising in Smith's Corners, Squash Hollow, Podunk, San Francisco, Chicago, or New York.

Consequently it would be just as much a civil wrong, or tort, for a physician to overexpose a patient to the roentgen rays in a diagnostic procedure in a large metropolitan or educational center as it would be in a backwoods village, and *vice versa,* irrespective of where he might be practising. The situation is exactly analogous to the

[1] Read by title at the Thirty-fourth Annual Meeting of the Radiological Society of North America, San Francisco, Calif., Dec. 5–10, 1948.

administration of a dose of morphine to a patient of given weight, whether in a small town in Arizona or in the Drake Hotel in Chicago. This point is well and clearly elucidated in a decision by the Supreme Court of Oregon, where it is stated, in King vs. Ditto, 19 Pac. R. (2nd) 1100:

"A physician and surgeon is not a guarantor of results ordinarily, however he impliedly contracts that he will exercise the degree of care and skill usually possessed and exercised by those engaged in the same line of practice in similar localities. As a general rule, the degree of care and skill depends somewhat upon locality. *But the duration of exposure, especially when the roentgen rays are not used for treatment, has become so fixed and exact that physicians are cognizant of it, whether they practice in Pumpkin Center or in New York City.* It would be negligence for a physician to expose a patient to the roentgen rays for the length of time claimed by the plaintiff, *regardless of the locality in which the physician was practising.* The trial court instructed the jury that the defendants were to be judged, not by the standard of care employed in all localities, but by the standard which is employed by physicians 'in localities like Rainier and similar localities.' Although this instruction was correct as a statement of the general rule, it was, as applied to the facts of this case, misleading and prejudicial. The patient was entitled to have the jury instructed that in the use of their x-ray machine, the defendant physicians were to be judged according to the standard of care, skill, and diligence that would have been exercised by 'a physician and surgeon of ordinary care and skill and diligence' under the same circumstances, *regardless of locality.*"[2]

Another ruling, by the Supreme Court of Virginia, in Hunter vs. Burroughs, 96 S.E.R. 360, holds that "*Urban and rural rule is not applicable to roentgenologists.* They must be up-to-date."

Supreme Courts in several states in this country have decided that injuries caused by the roentgen rays, dermatitis or so-called x-ray burns, produced during or as the result of the diagnostic use or application of the roentgen rays indicate malpractice. In some of these decisions the courts go so far as to specify that the maxim of *res ipsa loquitur* (the thing speaks for itself) applies in these cases. They hold that the production of an x-ray injury during or as the result of a diagnostic procedure is *prima facie* evidence of malpractice, and that the physician responsible for the injury must prove to the contrary.

In view of the foregoing, and because of numerous decisions implicating physicians who may be so unfortunate as to produce or even help to produce roentgen-ray injuries, particularly during or as the result of fluoroscopy or other diagnostic procedures, we should be on guard at all times against exposing our patients for too prolonged periods, what is commonly known as over-exposure. While the courts have many times stated in exact and unmistakable language that physicians are not to be held responsible for honest errors of judgment (with a single recent exception[3]), these same courts hold that roentgen-ray injuries, which are certainly errors of judgment, make the physicians inflicting them liable for damages.

It may be worth while at this point to state that, if the physician informs his prospective patient of his lack of skill and experience, and the patient still desires, consents to, and permits the application of the agent involved, the physician may not be held responsible. So that, while it may seem decidedly incongruous, if we would post a sign in our offices stating that we admit and declare that we know nothing about the application, uses, or effects of the roentgen rays, we would not, and legally could not, be held responsible for any injuries thus produced. This is because of the acknowledged lack of skill and follows an old but still respected law, a New York Supreme Court decision[4] part of which reads, "If a practitioner frankly informs the patient of his lack of skill or the patient is in some other way made fully aware of it, the latter cannot complain of that which he did not expect."

I have repeatedly stressed in previous papers and discussions the importance of accurate records of the exact time of exposure, the voltage and milliamperage

[2] Italics are the author's.

[3] See Radiology **48:** 282, March 1947.

[4] 88 Hun. N.Y.R. 200-30 Cvc. 1581.

used, the focal skin distance, and other elements of the exposure, as a material aid in the formulation of an adequate legal defense, should the need arise. A valuable and far too little used fluoroscope accessory is the integrating time switch. This very important and useful device may be installed at little expense, and, when used, will do more toward preventing overexposure, and consequent damage and injury, than any other single device. Calibration of apparatus and standardization of the output will enable us to know exactly the dose in roentgens being delivered. With this knowledge and the integrating time switch connected and *in use*, the fluoroscopist may and should feel amply prepared to keep well within the limits of safety.

The writer has on numerous occasions been asked for "the best way to defeat a malpractice suit." Usually he has given the trite but true reply: "Do not deserve to be sued." If you are sued, and a record is available covering time of exposure, voltage applied, milliamperage, anode skin distance, and filtration used, showing that the technic was within safe limits, no expert witness will say that the fault lay in the application of the rays, while at the same time it will be very easy to secure competent expert witnesses to testify that the methods used in the application of the alleged damaging agent were not at fault.

In considerably more than a few instances where the writer has reviewed the elements which were the apparent cause of roentgen-ray injuries following medical fluoroscopy, either the *records were deficient* or *entirely lacking* (none kept at all), the *time* consumed for the examination was too long, or the anatomical part being examined was *too near the x-ray tube*. The last two were, of course, definite causes of overdosage, while the first precluded any reason except over-exposure, without a record of the dose.

In fifteen instances of which the writer has intimate personal knowledge, where injuries resulting from fluoroscopic exposures were the alleged causes for malpractice suits, *every one was weak and lame in defense because of one or more of these important elements, and the plaintiffs secured a satisfactory financial settlement or a verdict and judgment in every case.* Analysis of these cases discloses that 10 of them were the result of fluoroscopic search for foreign bodies in the hands or feet; in 2 the injuries were incurred during the reduction of dislocations, and in the remaining 3 during the adjustment of fractures. In none of the 10 foreign-body cases were any records kept; dependence had to be placed solely on the memory of the participants, and as might be expected, no two witnesses agreed regarding the duration of exposure or the anode-skin distance. In one instance, a young physician (one of the plaintiffs) in an eastern state received irremediable damage to his hands. In another case, the physician defendant received a second-degree roentgen dermatitis. In one of the dislocation cases, so much radiation reached the dorsal aspect of the patient's (plaintiff's) shoulder that a deep third-degree roentgen dermatitis was produced, and this during use of *a regular fluoroscopic table where the anode-skin distance was fixed.* No record of any kind was kept and the defendant admitted that the voltage through the tube was twice raised in the course of the procedure. All the fracture cases occurred with the use of portable apparatus. In none of these were written records made at the time and two of the victims allegedly had to have amputations because of the roentgen injury.

It may be some slight consolation to us as radiologists to know that all of the foregoing fifteen serious and damaging injuries, for which the defendants or their insurers paid, were produced by general practitioners, who, had they been properly informed, would in all likelihood not have had this deplorable experience. In several (too many) other cases, however, in which fluoroscopy played a part in the production of roentgen-ray injuries, expert radiologists were held by the courts to be liable. In 2 of these instances the fluoroscopic examinations were made by technicians; but because the law says "*respondeat superior*,"

or the master is responsible, and the technicians were employees of the radiologists, the latter had to pay. Unfortunately in both of these instances, the radiologists had insurance for themselves and their partners *only*, and were not covered for the acts of their technicians. One of them had to pay a judgment of $2,500 and the other $500, beside the costs of the suits, attorneys, etc. In both these cases, the patients had had considerable previous exposure to x-rays, unknown to the technicians, which incidentally brings up a very important item relative to fluoroscopy.

Inquiry should invariably be made as to whether patients about to be examined (either fluoroscopically or by film) have had x-rays applied recently. In several instances within my own experience, redness of the skin was seen before the patient was examined and upon inquiry it was learned that x-rays had been previously used. In these cases, of course, the examinations were postponed.

The writer does not care to pose as an alarmist, but presents this subject after a rather extended experience in courts and in helping to defend malpractice suits. He wishes to stress earnestly the very definite and important need for serious thought regarding the medicolegal aspects of fluoroscopy.

Note: Since preparing this paper, it has come to my notice that one of the prominent insurance underwriters has adopted a clause in all medical malpractice policies, which reads as follows: "Notwithstanding anything contained herein to the contrary, it is specifically understood and agreed that the underwriters' total liability hereunder, in respect to 'malpractice' as insured hereunder, arising from the use of a portable fluoroscope or other fluoroscopes where a hand or head screen is employed, shall be limited to $2500 in all hereinunder in any one certificate year, and further, the assured or assureds named herein shall bear at their own risk and uninsured the first $500 for each and every loss where a hand or head screen is employed."

From the above, it will be seen that insurance underwriters are recognizing the dangers of fluoroscopy. It is altogether likely that other insurance companies will follow the lead of this one and include similar clauses in their contracts.

25 East Washington St.
Chicago 2, Ill.

SUMARIO

Connotaciones Médicolegales y Posición Legal de la Roentgenoscopia

El empleo cada vez mayor de la fluoroscopia por médicos que se familiarizaron con el método en el servicio militar, pero que habían tenido antes poca experiencia con los rayos X, impone una consideración detenida de los aspectos médicolegales del procedimiento. Las lesiones producidas durante el empleo diagnóstico de los rayos X han sido declaradas prueba de mala atención profesional por varios tribunales de los Estados de la Unión Americana.

En 15 casos de pleitos de este género, entablados por lesiones consecutivas a la roentgenoscopia y fallados en favor de los demandantes, desempeñaron un papel importante uno o más de los siguientes elementos: protocolos defectuosos con respecto a los factores de exposición, exposición prolongada e inadecuada distancia foco-piel.

EDITORIAL

Warren W. Furey, M.D.

President of the Radiological Society of North America

Do you want a boon companion on a vacation jaunt to the Wisconsin North Woods; a keen and clinically intuitive interpreter of a difficult radiologic problem; an eager, and occasionally very proficient, competitor in a game of golf; a sober judge and clear analyst of medical economic problems; a tireless worker for any cause in which he believes; an ebullient spirit with a flair for "gadgets," to trick you and provoke a round of laughter; an astute parliamentarian; an efficient organizer; a student of and contributor to the radiologic literature? Then you seek Warren William Furey, Jr., M.D., the recently installed president of the Radiological Society of North America.

Warren was born Jan. 8, 1898, in that section of the city of Chicago recently depicted by Arthur Meeker, in his story, "Prairie Avenue." It was a section of the famous First Ward, ruled for many years by "Hinky-Dink" Kenna and "Bath House John" Coughlin. Here was the elite St. James parish, which gave to Chicago many of its best judges and politicians, where Dr. John B. Murphy regularly led his retinue to Mass. It was also the scene of activity of the world-famous Eveleth sisters, in the Gay Nineties, and rumor has it that "Vic" Shaw still does business in the area. In this atmosphere, Warren W. Furey, Jr., had daily contact with the high and the low, and developed that sharp insight and boundless energy for which he is so notable today.

After receiving his grade and high school education at the St. James School, Warren studied premedical subjects at the University of Illinois and received his M.D. degree from Northwestern University Medical School in 1923. From this school, he recently received an alumnus award of Alpha Omega Alpha, an honor which escaped him by a narrow margin in his student days. Following internship at Mercy Hospital in Chicago, Warren married Veronica Lindstrom, and the young couple headed west.

After a year in Everett, Washington, the Fureys returned to Chicago. Warren entered the Department of Radiology of the Mercy Hospital, remaining until 1933. He became a diplomate of the American Board of Radiology in 1934. He was appointed radiologist to the Little Company of Mary Hospital in 1931, a post which he still holds. He also served, at various times, as radiologist to several other hospitals in and about Chicago, and was a member of the Department of Radiology of the Northwestern University Medical School. In 1944, he was appointed Director of the Department of Radiology at Mercy Hospital, and Assistant Professor of Radiology in the Stritch School of Medicine of Loyola University. He also established an office in the "Loop," and he and his associates serve as radiologists to several other hospitals and to the Municipal Tuberculosis Sanitarium.

A complete list of Warren's past and present offices is too lengthy to record here. The more important posts include: Secretary and President, Chicago Medical Society; Secretary, Vice-President, and President, Chicago Roentgen Society; Trustee, Chicago Roentgen Society; Trustee, Radiological Society of North America; Treasurer, American College of Radiology; Trustee, American Registry of X-ray Technicians; member of the Board of

Warren W. Furey, M.D.

President of the Radiological Society of North America

Directors, Tuberculosis Institute of Chicago; member of organizing group, member of Board of Directors, and Treasurer of the Illinois Medical Service (Blue Shield).

For relaxation, Warren likes to golf in the summer and bowl in the winter. At home, he and "Veron" take great pride in their four children, Rosemary, Virginia, Warren W., III, and Edward. And in turn, Warren's mother, age 71, and his father, age 78 (and still working daily), take justifiable pride in their son, his achievements, and his family.

The Radiological Society of North America can rest assured of experienced and competent guidance along the difficult trail ahead.

THEODORE J. WACHOWSKI, M.D.

The Thirty-Fifth Annual Meeting

The record registration of 2,284 at the Thirty-fifth Annual Meeting of the Radiological Society of North America affords ample evidence that the Society has outgrown the facilities available in Cleveland hotels. For the first time the Society held its meetings, exhibits, and refresher courses in convention hall surroundings. This assured everyone a seat and a chance to see and hear each speaker on the program, and plenty of room at the refresher courses. In Cleveland, the Municipal Auditorium is located conveniently near the downtown hotels and Cleveland weather was not as harsh on our southern visitors as it has been in former years.

The meeting got underway unofficially on Sunday afternoon, Dec. 4, with a lively therapy symposium led by Dr. William Harris, Dr. Kenneth E. Corrigan, Dr. Isadore Lampe, and Dr. Manuel Garcia. The moderator was Dr. Juan A. del Regato. Over eight hundred were in attendance at the popular film-reading session Sunday evening, from seven to nine o'clock. These two meetings were arranged by the Refresher Course Committee, under the local chairmanship of Dr. Carroll Dundon.

The general sessions began on Monday, with the call to order by Dr. Edgar P. McNamee, President. In his presidential address, "Cancer Diagnosis and Treatment," Dr. McNamee sounded the keynote of the meeting. Dr. Shields Warren, Director of the Division of Biology and Medicine of the Atomic Energy Commission, talked on "Progress and Trends in Cancer Research," pointing out that the intensive investigations now in progress with radioactive phosphorus, cobalt, and carbon, are being expanded to include special studies of other rarer radioactive elements to test their tissue storage and other physiological properties. He also summarized the progress made in the use of amethopterin and folic acid preparations in leukemia.

Each day of the meeting a general session was held in the morning, while in the afternoon two sessions were conducted, one in the Music Hall and one in the Little Theatre of the Municipal Auditorium. The Monday afternoon Diagnostic Session was a symposium on Cancer of the Stomach, under the chairmanship of Dr. Fred J. Hodges, who gave an excellent paper on "Standard Radiologic Methods Used in the Search for Gastric Tumors." Dr. Charles L. Brown presented the problem of early diagnosis of gastric carcinoma from the point of view of the internist, stressing the all-important responsibility of the physician who first sees the patient. Dr. Cesare Gianturco, who had an excellent exhibit on "Gastric Oil Contrast," discussed this method of examination and explained the technic he has evolved. In this symposium one of the most discussed papers of the entire meeting was presented by Dr. John Roach, who reported a study, carried out with Dr. Russell Morgan, on the routine photofluorographic study of patients for carcinoma of the stomach. Whether or not they agreed with the value of such a procedure, nearly all the radiol-

ogists who were present conceded that it was an interesting field for investigation.

Additional papers covering the gastrointestinal tract, with particular reference to the detection of cancer, were given in the general session Tuesday morning, Dec. 6. Radiologic examination of the small intestine was covered by Dr. Edward L. Jenkinson. Dr. Joseph C. Bell and Dr. Robert D. Moreton presented papers on the roentgenographic examination of the colon. The "Diagnosis of Intrathoracic Tumors" was the subject of a symposium under the chairmanship of Dr. Laurence L. Robbins. It began in the morning session and continued through Tuesday afternoon. Dr. Chevalier W. Jackson stressed the necessity for uniformity in pulmonary anatomical description.

The Wednesday morning general session was devoted to a symposium on Bone Tumors, led by Dr. Aubrey O. Hampton. Dr. Edward B. D. Neuhauser opened the afternoon Diagnostic Session with an interesting paper on diastematomyelia, with myelographic studies establishing the diagnosis. This was followed by papers dealing with leukemia, neuroblastomas, Wilms' tumor, and a rare case of adenocarcinoma of the choroid plexus.

"Tumors of the Urinary Tract" was the subject of a symposium on Thursday morning, and on Thursday afternoon the Diagnostic Session, under the chairmanship of Dr. Merrill C. Sosman, discussed "Diseases and Tumors of the Skull and Brain." Dr. Barton R. Young and Dr. John D. Camp gave interesting papers on general roentgen diagnosis in cerebral lesions. Doctor Camp's paper contained many valuable criteria on the significance of intracranial calcification and pineal shadow displacement. Dr. Carl List's paper on "Cerebral Angiography" emphasized again the fundamental contribution he has made to our present understanding of the method. Dr. Fred J. Hodges emphasized the necessity for standardization of the technic of cerebral pneumography and stressed the value of this well established procedure. Dr. George E. Moore gave a stimulating paper on the usefulness of sodium fluorescein in the localization of brain tumors at operation. Radioactive dyes of the fluorescein group have been employed in experimental work in an attempt to locate and diagnose brain tumors preoperatively. The method has not yet been encouraging for clinical use, but it may lay the groundwork for development of useful methods in the future.

Dr. Cushman D. Haagensen, Dr. Vincent P. Collins, Dr. Ira T. Nathanson, and Dr. Grantley W. Taylor, distinguished guests of the Society, participated in the opening Therapy Session, a symposium on "Treatment of Cancer of the Breast." In the opening paper of the Tuesday afternoon symposium, Dr. Carl B. Braestrup called attention to the hazard of beta ray applicators, now commonly used in nasopharyngeal lymphoid hyperplasia If cases are not carefully selected an overdose may easily be delivered. The remainder of the session was devoted to the various phases of upper respiratory tract tumors and cervical node metastases resulting therefrom.

The Wednesday afternoon Therapy Session took the form of a Tumor Conference, with Dr. Eugene P. Pendergrass directing the discussion. Actual cases were presented, methods of management were considered, and a discussion of various forms of treatment proceeded in a lively fashion. In addition to radiology, other specialties were represented on the tumor board, namely, pathology, internal medicine, surgery, and urology. There was a very comprehensive coverage of the subject "Cancer of the Cervix Uteri" in the Thursday afternoon session; Dr. Gerald H. Galvin covered thoroughly the problems of diagnosis, while Dr. Erle Henriksen of Los Angeles, a guest of the Society, took up the anatomy and surgical treatment of this disease. The role of radiation treatment was discussed by Dr. James F. Nolan and Dr. Gilbert Fletcher.

In his customary illustrious manner, Dr. John D. Camp gave the Annual Carman Lecture, taking as his subject "Contrast Myelography Past and Present."

Presentation of the Gold Medal of the Society. Left to right, Dr. John D. Camp; Dr. Edgar P. McNamee, President, and Dr. Donald S. Childs

He stressed particularly the diagnostic usefulness of the method and, in addition, covered the history and uses of various contrast media.

The Friday sessions took up the newer developments in radiology and correlated fields. Dr. Ralph Jones read a paper concerning the role of chemotherapeutic agents in the treatment of tumors, a procedure which, when better understood, will undoubtedly play a significant part in cancer therapy. Dr. Russell H. Morgan reported on the advances in fluorophotography with the Schmidt camera. This optical system is similar to that employed by astronomers and, combined with a rapid processing technic, reduces considerably the quantity of radiation needed to obtain a diagnostic fluorophotographic image. Dr. Morgan's paper aroused considerable comment on the part of his listeners, who felt that as radiologists we must watch carefully that quality of examination does not give way to quantity.

In the closing session on Friday afternoon Dr. Lauriston Taylor, taking the place of Dr. C. Failla, who was ill, presented briefly some of the new developments in the field of energy absorption units, and Dr. Robert R. Newell called attention to the widely divergent opinions on human tolerance for total-body irradiation, an important subject if atomic warfare were to come.

In accordance with the usual custom, the Annual Banquet was held Thursday evening, in the Hotel Statler. The members, their ladies, and guests of the Society enjoyed the usual preliminaries. The Society awarded two Gold Medals, one to

Dr. Donald S. Childs for his many years of valuable service to the Society as Secretary and Treasurer, and the other to Dr. John D. Camp, Carman Lecturer, Associate Editor of RADIOLOGY, and devoted leader of the educational work of the Society.

Awards were also made for the outstanding scientific exhibits, as recorded elsewhere in this issue.

The new officers of the Society were introduced, as follows: Dr. Warren W. Furey, Jr., President; Dr. John S. Bouslog, President-Elect; Dr. Leo G. Rigler, First Vice-President; Dr. Sydney J. Hawley, Second Vice-President; Dr. Edward B. D. Neuhauser, Third Vice-President; Dr. Donald S. Childs, Secretary-Treasurer; Dr. Howard P. Doub, Librarian.

The organization of a large meeting of this sort commands innumerable notes of thanks and acknowledgment to all who managed the many details. The Public Auditorium Convention Manager, Mr. Hurd, and Mr. Martin I. Sperber, whose responsibility it was to supply lanterns, screens, operators, and amplifiers, both deserve credit for a job well done. The local Executive Committee, under the chairmanship of Dr. Harry Hauser, is to be congratulated on its organizational work. Mrs. George L. Sackett, chairman of the Ladies' Entertainment Committee, extends thanks to her energetic and able committee, Mrs. Edgar P. McNamee, Mrs. Hymer L. Friedell, Mrs. Ursus V. Portmann, Mrs. Harry Hauser, Mrs. Carroll C. Dundon, Mrs. Donald D. Brannan, Mrs. George R. Krause, Mrs. John O. Newton, Mrs. Arthur H. Schumacher, and Mrs. John D. Osmond, Jr.

GEORGE L. SACKETT, M.D.

Dr. John Bouslog, President-Elect, and Mrs. Bouslog

The Refresher Courses

The Refresher Course Committee offered a total of thirty-six courses at the Thirty-fifth Annual Meeting of the Radiological Society of North America in Cleveland. The object was to cover as many topics as possible, with the idea of repeating several of the courses at least for two or three years so that men who did not have the opportunity to attend all the courses they desired this year might do so at future sessions. Some special courses were included, however, which obviously cannot be repeated each year, but in so far as possible the basic topics will be covered at each meeting.

The comments from the "students" were with few exceptions highly favorable, and the interest in the courses remains active. Registrants came from several foreign countries and practically all states were represented.

The Committee takes this opportunity to thank all of the instructors; namely, Dr. William Harris, K. E. Corrigan, Ph.D., Dr. Isadore Lampe, Dr. Manuel Garcia, Dr. Carroll C. Dundon, Dr. L. Henry Garland, Dr. Leo G. Rigler, Dr. Laurence L. Robbins, Dr. Merrill C. Sosman, Dr. Martin H. Wittenborg, Dr. Barton R. Young, Dr. Lilian Donaldson, Dr. Richard Schatzki, Dr. B. V. A. Low-Beer, Dr. Milton Friedman, Dr. Rolfe M. Harvey, Dr. Agrippa G. Robert, Dr. L. W. Paul, Dr. Walter W. Vaughan, H. M. Parker, Ph.D., Dr. Jacob R. Freid, Dr. Clara O'Krainetz, Dr. John S. Bouslog, Dr. Russell Nichols, Dr. Robert D. Moreton Edith H. Quimby, Sc.D., Dr. John Caffey

Dr. C. Howard Hatcher, Dr. Lois C. Collins, Dr. Franz Buschke, Dr. U. V. Portmann, and Dr. William E. Costolow; and especially Dr. Paul C. Hodges, Dr. J. A. del Regato, Dr. Edward B. D. Neuhauser, Dr. Robert P. Barden, and Dr. Ross Golden, who helped arrange the series. Dr. Carroll C. Dundon and his local committee are also deserving of our special thanks.

REFRESHER COURSE COMMITTEE
Paul C. Swenson, M.D.
Kenneth S. Davis, M.D.
C. Edgar Virden, M.D., Chairman

The Scientific Exhibits

A widely diversified group of thirty-eight scientific exhibits of outstanding quality was assembled at the Thirty-fifth Annual Meeting of the Radiological Society of North America, Dec. 4 to 9, 1949.

The First Award was given to E. B. D. NEUHAUSER, M.D., AND M. H. WITTENBORG, M.D. (*Boston, Mass.*) for their exhibit on "Diastematomyelia," consisting of reproductions of roentgenograms showing congenital transfixation of the spinal cord by an osseous spicule, with widening of the neural arch due to division of the cord.

The Second Award was received by JAMES F. NOLAN, M.D., WILLIAM E. COSTOLOW, M.D., AND LUCILLE DUSAULT, M.D. (*Los Angeles, Calif.*) for their exhibit on "Radium Treatment in Carcinoma of the Cervix Uteri."

The Third Award was made to CESARE GIANTURCO, M.D. (*Urbana, Ill.*) for his exhibit on "Gastric Oil Contrast," studies of the stomach with films showing double contrast obtained by the administration of barium and mineral oil.

The exhibit of J. GERSHON-COHEN, M.D. AND A. G. COOLEY (*Philadelphia, Penna.*) on "Roentgenologic Facsimile for Rural Hospital" received Honorable Mention.

Honorable Mention was also given to F. J. HODGES, M.D., W. H. THOMPSON, M.D., AND M. M. FIGLEY, M.D. (*Ann Arbor, Mich.*) for their exhibit on "Full Cycle Angiocardiography."

A Certificate of Merit was awarded to C. A. STEVENSON, M.D., ROBERT D. MORETON, M.D., and E. E. SEEDORF, M.D. (*Temple, Tex.*) for their exhibit on "The Roentgenologic Demonstration of Obscure Lesions of the Colon."

Educational value, scientific contribution and originality were attributes of most of the remaining exhibits, as follows:

W. S. ALTMAN, M.D. (*Quincy, Mass.*): "A New Therapy Chart for Teaching Services."

VINCENT W. ARCHER, M.D., GEORGE COOPER, JR., M.D., H. D. HEBEL, M.D., DORRIS CUNNINGHAM, M.D. (*University of Virginia*): "Lead Glass Fabric: Protection Against X-rays and Beta Rays of Atomic Fission Products."

ERIC V. BAEYER, M.D. (*Cleveland, Ohio*): "Congenital and Acquired Obstruction of the Alimentary Tract in the Newborn and Infant."

C. F. BEHRENS, Capt., M.C., H. C. DUDLEY, Comdr., M.C., J. L. TULLIS, Comdr., M.C., E. P. CRONKITE, Lt. Comdr., M.C., AND F. W. CHAMBERS, Lt. Comdr., M.C. (*Bethesda, Md.*): "A Few Modern Aspects of Radiologic Research at the Naval Medical Research Institute."

DONALD W. BORTZ, M.D. (*Cleveland, Ohio*): "Multiple Myeloma."

CURTIS H. BURGE, M.D., AND R. G. DUNN, M.D. (*Houston, Tex.*): "Myelography in the Diagnosis of Ruptured Intervertebral Disks."

CHARLES S. CAMERON, M.D., AND C. E. WILBUR, M.D. (*New York*): "American Cancer Society—Organization and Program."

CHARLES T. DOTTER, M.D., ISRAEL STEINBERG, M.D., AND HAROLD L. TEMPLE, M.D. (*New York, N. Y.*) "An Automatic X-ray Roll Film Magazine for Angiocardiography."

SOLOMON FINEMAN, M.D., A. GRINO, M.D., E. FEIRING, M.D., AND LEO DAVIDOFF, M.D. (*New York, N. Y.*): "Cerebral Angiography in the Diagnosis of Brain Tumors, with Demonstration of a Practical Cranial Serialograph."

GILBERT H. FLETCHER, M.D., AND JOHN A. WALL, M.D. (*Houston, Tex.*): "Correlation of Radium and External Irradiation in Cancer of the Cervix."

CHARLES E. GRAYSON, M.D., AND DELLIVAN M. FUIKS, M.D. (*Sacramento, Calif.*): "Spontaneous Vacuum Phenomena in Hip Joint Dysplasia."

C. B. HOLMAN, M.D., AND JOHN D. CAMP, M.D. (*Rochester, Minn.*): "Lateralizing Identification Method for Roentgenograms."

VERNON E. JOHNSON, R.T. (*Sioux Falls, S. D.*): "The American Society and The American Registry of X-ray Technicians."

GEORGE R. KRAUSE, M.D., AND MORTIMER LUBERT, M.D. (*Cleveland, Ohio*): "Bronchopulmonary Segments as Demonstrated by Disease."

EDWIN L. LAME, M.D., AND HON CHONG CHANG, M.D. (*Philadelphia, Penna.*): "Pubic and Ischial Necrosis Following Pelvic Surgery (Osteitis Pubis)."

H. F. A. LONG, ROBERT J. ANDERSON, M.D., CARROLL PALMER, M.D., AND IRA LEWIS, M.D. (*Washington, D. C.*): "Pulmonary Infiltrates in Student Nurses Associated with Conversion and Tuberculin Sensitivity."

THEODORE B. MASSELL, M.D., JACK R. VOSKAMP, M.D., AND FRANK ISAAC, M.D. (*Los Angeles, Calif.*): "Phlebography in Peripheral Venous Disease."

A. MELAMED, M.D., R. HAUKOHL, M.D., AND E. MENSING, M.D. (*Milwaukee, Wis.*): "Prolapse of Gastric Mucosa into Duodenum."

EVERETT L. PIRKEY, M.D., EDSEL S. REED, M.D., WILLIAM H. SMITH, M.D., AND H. D. KERMAN, M.D. (*Louisville, Ky.*): "New Contrast Medium for Use in Radiography."

RAPHAEL POMERANZ, M.D., HENRY A. BRODKIN, M.D., AND HARRISON S. MARTLAND, M.D. (*Newark, N. J.*): "Beryllium Granulomatosis."

G. H. RAMSEY, M.D., J. S. WATSON, JR., M.D., S. A. WEINBERG, M.D., F. W. DREISINGER, M.D., AND J. J. THOMPSON, M.D. (*Rochester, N. Y.*): "Diagnostic Cinefluorography."

L. REYNOLDS, M.D., K. E. CORRIGAN, Ph.D., J. O. REED, M.D., H. S. HAYDEN, Ph.D. (*Detroit, Mich.*): "Diagnostic Tracer Technique."

BERNARD ROSWIT, M.D., JOSEPH SORRENTINO, M.D., AND ROSLYN YALOW, Ph.D. (*Bronx, N. Y.*): "The Diagnostic Role of Radioactive Isotopes."

MAURICE D. SACHS, M.D., AND P. F. PARTINGTON, M.D. (*Cleveland, Ohio*): "Routine Operative Cholangiography."

HAROLD N. SCHWINGER, M.D., AND BERNARD EHRENPREIS, M.D. (*Brooklyn, N. Y.*): "Roentgen Manifestations of Sickle-Cell Anemia."

WENDELL G. SCOTT, M.D., WILLIAM B. SEAMAN, M.D., AND THOMAS KEELY, M.D. (*St. Louis, Mo.*): "Cerebral Angiography."

GEORGE S. SHARP, M.D., AND FRANK C. BINKLEY, M.D. (*Pasadena, Calif.*): "Cysts and Tumors of the Jaws."

J. J. SHER, M.D., AND WILLIAM HOWES, M.D. (*Brooklyn, N. Y.*): "Thorium X in the Treatment of Epitheliomas, Keratoses, and Irradiation Changes."

C. H. SLOCUMB, M.D., AND SMITH FREEMAN, M.D. (*Rochester, Minn.*): "Vitamin D Poisoning in Human Subjects."

SCOTT SMITH (*U. S. Army and National Bureau of Standards, Washington, D. C.*): "Military Field X-ray Equipment."

E. C. STAFNE, D.D.S., L. T. AUSTIN, D.D.S., AND S.A. LOVESTEDT, D.D.S. (*Rochester, Minn.*): "Dental Roentgenologic Findings in Systemic Disease."

E. D. TROUT AND W. T. HAM (*Milwaukee, Wis.*): "Million-Volt Beryllium Window X-ray Equipment for Bio-Physical and Bio-Chemical Research."

CLARENCE E. HUFFORD, M.D.

Commercial Exhibit at the Thirty-fifth Annual Meeting, with the Scientific Exhibits at the extreme right and left

The Commercial Exhibit

The commercial exhibits at the Thirty-fifth Annual Meeting of the Radiological Society of North America filled the central portion of the Arena of the Cleveland Municipal Auditorium. A record number of eighty-six booths, each at least 10 × 10 feet square, was occupied. The ample space, as well as the excellent service rendered by the Auditorium management, made the Commercial Exhibit a splendid and happy one. Forty-four exhibitors participated.

ALLIS-CHALMERS MANUFACTURING COMPANY (*Milwaukee, Wis.*) exhibited a large color view of the new 24-million-volt angulating betatron, designed especially for therapy with precision beam placement. Construction views of the 22-million-volt stationary betatron, in color, and a scale model of a typical betatron therapy installation were shown. Isodose distributions were on display.

ANSCO CORPORATION (*Binghamton, New York*) featured a series of interesting radiographs on both Ansco high-speed and non-screen films. Among the films were several examples of high-kilovoltage technics. In addition, Ansco high-speed film for angiocardiography was shown. The exhibit included also a group of Ansco color transparencies. The entire line of Ansco cameras was demonstrated.

AUTOMATIC SERIOGRAPH CORPORATION (*College Park, Md.*) displayed the improved seriograph, a means of obtaining all types of angiograms. In conjunction with standard x-ray equipment, it will take up to eight roentgenograms on standard 11 × 14-inch film. The device is completely portable and requires no modification of the x-ray equipment. A component part of the seriograph is an automatic timer, permitting ranges from 0.5 to 2.0 seconds between exposures. Releasing a foot switch at any time stops the mechanism at the completion of a single picture cycle.

BUCK X-OGRAPH COMPANY (*St. Louis, Mo.*) demonstrated its well known line of view boxes, film-drying and film-storage cabinets. Literature was distributed, illustrating Buck cassettes and developing room equipment.

CALCULEX COMPANY (*Dallas, Tex.*) had on display an electronically operated instrument, which simultaneously multiplies, divides, adds, and subtracts, solving algebraically across the electrical circuit every equation used in calculating x-ray factors. The desired factors are indicated by control knobs, and a push button is then depressed, which allows a needle to indicate the proper kilovoltage on a dial.

CANADIAN RADIUM & URANIUM CORPORATION (*New York, N. Y.*) showed a complete line of radium applicators, featuring particularly the new ophthalmic applicator, utilizing radium D.

CORECO RESEARCH CORPORATION (*New York, N. Y.*) featured a practically automatic camera, designed for surface and intracavity photography, as well as for copying of colored illustrations and radiographs, using colored film.

DUNLEE CORPORATION (*Chicago, Ill.*) showed their complete line of x-ray and valve tubes, all featuring the use of a getter, provided in a simple and effective manner on electrically unstressed glass of the envelope. Also displayed was their new low-wattage filament valve. These valves, with thoriated tungsten filaments in place of pure tungsten, require less watts of filament power than the type commonly used.

E. I. DU PONT DE NEMOURS COMPANY (*Wilmington, Del.*) conducted a radiographic quiz, in which doctors were invited to "diagnose" exposure or processing defects in a series of twelve radiographs. The defects ranged from kink marks and chemical stains to poor cassette contact. The exhibit also included two turntables, displaying du Pont x-ray films and chemicals and "Patterson" intensifying screens.

EASTMAN KODAK COMPANY (*Rochester, N. Y.*) had a display of Eastman processing

chemicals, films, and processing room equipment. Also shown was the Eastman line of general purpose and clinical cameras. The new Kodak Fluorolite camera combination was on view.

ELDORADO MINING & REFINING COMPANY, LTD. (*Ottawa, Ontario*) displayed, in addition to standard radium and accessory equipment, a set of Gusberg endocervical curettes and a new radium dosage calculator. The principal feature of the calculator is its utility in computations pertaining to Paterson-Parker dosimetry and in radon therapy technics.

EMSCO X-RAY ACCESSORY COMPANY (*Burbank, Calif.*) showed their line of x-ray accessories, including the therapy visualizer with built-in periscope for field irradiation and intracavity therapy. Intracavitary cones of various sizes were displayed. A radiograph visualizer, with film centering light and a Universal cone which covers the complete radiographic field, was demonstrated.

EUREKA X-RAY TUBE CORPORATION (*Chicago, Ill.*) displayed their complete line of x-ray and valve tubes. Their new oil-immersed shock-proof rotating anode tube for fluoroscopy and spot-film work was shown for the first time.

FAIRCHILD CAMERA & INSTRUMENT CORPORATION (*Jamaica, N. Y.*) showed an especially designed camera for rapid radiography.

H. G. FISCHER & COMPANY (*Franklin Park, Ill.*) demonstrated a tilt table with an over- and under-the-table tube and fluoroscopic attachment.

FRANKLIN X-RAY COMPANY (*Philadelphia, Penna.*) exhibited its special head radiography unit, a view box for viewing films made with the Fairchild type camera, and a photograph of their newly designed, streamlined radiographic table. The Franklin Company's radiographic timing selector, allowing for a choice of any one or all exposures every half second for twenty seconds, was demonstrated in the Liebel-Flarsheim booth.

GENERAL ELECTRIC X-RAY CORPORATION (*Milwaukee, Wis.*) showed their latest model radiographic table, a 250-kilovoltage Maximar type therapy unit, and the newly developed 250-kilovoltage resonant therapy generator, featuring a beryllium window.

GIBBS DIVISION, GEORGE W. BORG CORPORATION (*Delavan, Wis.*) showed their Quadro-matic Deluxe diagnostic unit. The table and transformer were equipped with transparent tops, to show the working parts. A feature was the oil-immersed positive-action high-tension switch. The Thera-matic deep therapy unit control was shown, as were photographs of the tube stand and tube head.

PAUL B. HOEBER, INC. (*New York, N. Y.*) displayed a large line of general medical and radiological textbooks. The list included many of the old "stand-bys," as well as excellent, more recent publications. Copies of *Cancer*, published for the American Cancer Society, were available.

KELLEY-KOETT MANUFACTURING COMPANY (*Covington, Ky.*) had two separate exhibits. One showed a newly developed overhead radiographic tube holder, a radiographic table tilting to 45° Trendelenburg, monitoring equipment for detection of radiation hazards, and other items. In their other booth there was depicted historically and chronologically the development of knowledge in electricity and electronics. The Company is celebrating its fiftieth anniversary.

LIEBEL-FLARSHEIM COMPANY (*Cincinnati, Ohio*) displayed their line of x-ray timing equipment. The exhibit centered around the new Thyr-X Impulse Timer. This new device employs large thyratron tubes to switch the x-ray transformer primary current, allowing exposures at as rapid a rate as thirty per second, to permit synchronization of the x-ray exposure with the movement of film in an x-ray motion picture camera. The Thyr-X contactor can be time-controlled by a phototimer, a roentgenkymograph, or by the Thyr-X synchronous motor-driven time switch, which is mounted in the x-ray control panel and presents a continuous scale of time intervals from 1/60 second to 14 seconds.

MACHLETT LABORATORIES, INC. (*Springdale, Conn.*) exhibited two x-ray tubes, known as types EG-25 and OEG-60, of revolutionary design, intended for grenz-ray and superficial therapy applications. One of these units employs a ceramic envelope, a new vacuum-tube technic developed during the war, instead of the conventional glass bulb, and both are equipped with beryllium windows, arranged to permit the x-ray beam to be taken off the end of the tube. The Super Dynamax 125-kv. rotating anode tube, designed to meet the greater load demand of angiocardiography, cinefluorography, and high-voltage radiographic technic, was likewise an item of interest. Also shown was the "Donut" for the 22-million-volt betatron.

F. MATTERN MANUFACTURING COMPANY (*Chicago, Ill.*) introduced their new 250-kv. constant-potential deep-therapy unit, incorporating an unusually small tube head mounted on a floor-ceiling tube stand. A newly designed cassette changer for chest filming was demonstrated.

THOMAS NELSON & SONS (*New York, N. Y.*) displayed a large line of publications featuring those pertaining to radiology. Others in related specialty fields were also shown.

H. G. ODMANN, INC. (*Leonia, N. J.*) demonstrated their complete line of direct view and periscopic intracavitary cones. Also shown were superficial therapy cones, as well as special transparent deep-therapy cones. A feature was the Odmann Therapy Field Indicator, and of considerable interest were the new mounting bases allowing for more positive locking of the various cones and adaptors.

PAKO CORPORATION (*Minneapolis, Minn.*) showed their automatic film developing and drying unit and a model of a hypo "in-the-wall" passbox.

PICKER X-RAY CORPORATION (*New York, N. Y.*) displayed the new Constellation x-ray table, incorporating the 45° Trendelenburg tilt. It features magnetic locks throughout, and electrically-motor driven shutters. The new Picktronic 300- and 500-milliampere controls were displayed. The latter incorporated complete phototiming, high kilovoltage range, and extra timing range. In a separate exhibit were shown accessories, including the Anhydrator, Angiograph, and the Demy Therapy Beam Localizer.

PROFESSIONAL EQUIPMENT COMPANY (*Chicago, Ill.*) showed a superficial x-ray therapy unit, with a self-contained tube head.

RADIOLOGY (*Detroit, Mich.*), the official journal of the Radiological Society of North America, was represented by the editorial assistants, who were ready with advice and suggestions to prospective contributors. Complimentary copies of recent issues were distributed.

RADIUM CHEMICAL COMPANY (*New York, N. Y.*) showed a large line of radium applicators and accessories.

SCHERING CORPORATION (*Bloomfield, N. J.*) featured Neo-Iopax for Intravenous pyelography and Priodax for oral cholecystography.

FRANK SCHOLZ X-RAY ENGINEERING SERVICE (*Boston, Mass.*) displayed the Scholz six-on-one spot film device, incorporating a time selector switch located on the fluoroscopic screen frame.

SERIOGRAPH MANUFACTURING COMPANY (*Glendale, Calif.*) showed an automatic cassette changer equipped with two speeds. At high speed, it takes six roentgenograms in approximately 4 1/2 seconds, at intervals of 0.7 second, including exposure time, while at low speed, it takes six roentgenograms in approximately 10 seconds; 10 × 12-inch films are used.

STANDARD X-RAY COMPANY (*Chicago, Ill.*) exhibited a 250-kvp. constant-potential deep-therapy unit. With this, a console control was shown. Also demonstrated were a 70-mm. miniature radiographic unit and a new and modern control panel for use with radiographic generators.

CHARLES C THOMAS, PUBLISHERS (*Springfield, Ill.*) had a large exhibit of standard and specialty publications, featuring those relative to radiology. Also of interest was an exhibit of rare and old volumes, particularly the predecessors of

the present *American Journal of Roentgenology and Radium Therapy.*

VAN LEER INSTRUMENT COMPANY (*Pittsfield, Mass.*) demonstrated a new type miniature film camera using reflecting surfaces and a 70-mm. film, for which unusual speed, as well as sharpness to the periphery, was claimed.

VICTOREEN INSTRUMENT COMPANY (*Cleveland, Ohio*) showed a large line of radiation detection instruments, designed for health protection, as well as beta and gamma survey work.

WEBSTER PHOTOCRAFT (*Webster Groves, Mo.*) featured an atlas of miniature roentgenograms. Also shown were two projection machines, designed for projecting the original film on a screen.

WESTINGHOUSE ELECTRIC CORPORATION (*Pittsburgh, Penna.*) exhibited latest equipment for angiography, including their 1/120th second Contax electronic timer, Cyclex sequencing device, and a Fairchild Roll Film Cassette, mounted in a tilting radiographic table. It was demonstrated that exposures could be made in any desired sequence or could be pulsed by an Edin Cardiograph. A new Exposure Monitor for Cassette Changer was also shown, as well as a 200-ma. Westex Control, 200-ma. and 300-ma. Autoflex controls, Duoflex Table with four-on-one spot film device, 250-kv. and 220-kv. therapy controls, and the Lysholm Precision Skull Unit. Complete processing facilities were shown, including a model darkroom and reading room. Illuminators and film-filing cabinets were on display.

WINTHROP-STEARNS COMPANY (*New York, N. Y.*) showed illustrations of the use of Diodrast for intravenous pyelography and angiocardiography. Literature also was available on Demerol, pHisoderm, and Skiodan Sodium.

WOLF X-RAY PRODUCTS, INC. (*New York, N. Y.*) exhibited a large line of x-ray protective gloves and aprons, as well as x-ray film illuminators, processing equipment, and film-storage cabinets.

WRENCO, INC. (*Mountain Lakes, N. J.*) showed an improved model of the "Videx," an adjustable radiographic cone with a range of coning from full coverage of a 14 × 17-inch film to a spot of less than 5 inches diameter. A pre-focus light showed the central x-ray beam. A scale showed the diaphragm opening for all target-film distances. A double adjustable diaphragm model was available for higher kilovoltages.

T. J. WACHOWSKI, M.D.

SIXTH INTERNATIONAL CONGRESS OF RADIOLOGY LONDON, 1950

The following "reminder" was received too late for publication in the January issue, but some of the information contained in it may still prove useful to those planning to attend the International Congress of Radiology in London, July 23–30, 1950.

"A copy of the Preliminary Programme, together with the necessary forms for completion, has been sent to all members of radiological societies throughout the world. All those planning to attend are urged to register as Members of the Congress as soon as possible.

"There are three classes of members: Full Members (including Junior, for those under thirty), Associates accompanying Full Members, and Scientific and Technical Associates. All are reminded that a higher fee will be charged for registrations received after April 1st.

"Members wishing to read papers must notify the Secretary-General not later than February 15th, and an abstract should reach him by April 1st. Those who have a scientific exhibit to offer must also send details by February 15th.

"Application to join one of the tours of Great Britain and Ireland which are being organized for the week following the Congress must be received by February 15th.

"All communications should be sent to Dr. J. W. McLaren, Secretary-General, 6th International Congress of Radiology, 45 Lincoln's Inn Fields, London W.C.2.

"Additional copies of the Preliminary Programme can be obtained from the same address on request, stating the language in which it is desired."

SECOND CONGRESS OF RADIOLOGY ARGENTINA

The Second Congress of Radiology (Segundo Congreso de Radiología) will be held in Tucumán, Argentina, May 26–31, 1950, under the auspices of the Radiological Association of Argentina (Asociación radiológica de Argentina) and the University of Tucumán (Universidad de Tucumán). Participating in the meeting will be the Radiological Society of Chile (Sociedad de Radiología de Chile); the Radiological Institute of Uruguay (Instituto de Radiología del Uruguay); the Brazilian Society of Radiology (Sociedad brazilera de Radiología); and the Chair of Radiology of Paraguay University (Cátedra de Radiología del Paraguay).

The Executive Committee, headed by Dr. Sabino Di Rienzo, President, and Dr. Lidio G. Mosca, Secretary, has announced these official themes for the Congress: Nomenclature of Bronchial and Segmental Architecture; Tumors of the Colon; Tumors of the Esophagus. A fourth session will be devoted to various other topics related to radiological diagnosis and therapy.

ROCHESTER ROENTGEN RAY SOCIETY

At the annual meeting of the Rochester Roentgen Ray Society in December 1949, the following officers were elected: President, Dr. E. Forrest Merrill; Vice-President, Dr. Ralph E. Alexander; Secretary-Treasurer, Dr. A. Vaughn Winchell, 40 Meigs St., Rochester, N. Y. Meetings are held on the last Monday of each month, from September through May, at Strong Memorial Hospital.

INTERNATIONAL CONGRESS ON DISEASES OF THE CHEST

The First International Congress on Diseases of the Chest will be held at the Carlo Forlanini Institute, Rome, Italy, Sept. 17–20, 1950, under the auspices of the Council on International Affairs of the American College of Chest Physicians and the Carlo Forlanini Institute, with the patronage of the High Commissioner of Hygiene and Health, Italy, in collaboration with the National Institute of Health and the Italian Federation Against Tuberculosis.

Physicians who are interested in attending the Congress should communicate at once with Dr. Chevalier L. Jackson, Chairman of the Council on International Affairs, American College of Chest Physicians, 500 North Dearborn Street, Chicago 10, Illinois, U.S.A., or with Professor A. Omodei Zorini, Carlo Forlanini Institute, Rome, Italy.

Letter to the Editor

To the Editor of Radiology

DEAR DR. DOUB:

I hope that you will see fit to publish these few paragraphs in RADIOLOGY, since many of the radiologists who have called me at the insistence of patients or relatives of patients have agreed that an authorized statement in print would be helpful.

The recent newspaper publicity on the Medical Betatron at the University of Illinois College of Medicine is totally unauthorized and grossly exaggerated. One national magazine has, in spite of warning, distorted facts to the point of absurdity.

I am neither optimistic nor enthusiastic about the ability of the Betatron to solve the cancer problem. In its present state it may be helpful in about 10 per cent of cancer patients. It is not suitable for widespread cancer, terminal situations, or in cancers of a radiation-resistant type.

Physicians having relatives or patients afflicted with cancer are urged to institute prompt and aggressive treatment by accepted methods in their own communities. We can test so few patients a month on the Betatron that the charity Tumor Clinic in Research and Educational Hospital in Chicago can supply our needs without outside referrals.

Yours truly,

ROGER A. HARVEY, M.D.

Professor of Radiology, Chairman of the Department, University of Illinois, College of Medicine, Chicago, Ill.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

INTESTINAL INTUBATION. By MEYER O. CANTOR, M.S., M.D., F.A.C.S., Assistant Attending Surgeon, Grace Hospital; Formerly, Senior Attending Surgeon, Deaconess Hospital, Detroit, Mich. A volume of 333 pages, with 147 figures. Published by Charles C Thomas, Springfield, Ill., 1949. Price $7.50.

CLINICAL RADIATION THERAPY. Edited by ERNST A. POHLE, M.D., Ph.D., F.A.C.R., Professor of Radiology and Chairman, Department of Radiology, University of Wisconsin, Madison, Wisconsin. A volume of 902 pages, with 314 illustrations on 201 figures, and 16 diagrams; 1 plate in color. Second edition, enlarged and thoroughly revised. Published by Lea & Febiger, Philadelphia, 1950. Price $15.00.

L'ORGANISATION DES OS. By PIERRE LACROIX, Professor of the Faculty of Medicine of Louvain. A volume of 230 pages, with 87 illustrations. Published by Desoer, Liège; Masson et Cie, Paris, 1949.

LES TUMEURS MALIGNES DES VOIES AÉRO-DIGESTIVES SUPÉRIEURES. By J. DUCUING, Professor of Clinical Surgery and of Cancer and Director of the Anti-Cancer Center of Toulouse, and L. DUCUING, Former Laryngologist of the Anti-Cancer Center of Toulouse. A volume of 582 pages, with 170 illustrations. Published by Masson et Cie, Paris, 1949.

MICROPHTHALMOS AND ANOPHTHALMOS WITH OR WITHOUT COINCIDENT OLIGOPHRENIA. A CLINICAL AND GENETIC-STATISTICAL STUDY. By TORSTEN SJÖGREN AND TAGE LARSSON. Supplementum 56 to Acta psychiatrica and neurologica. A volume of 104 pages, with 8 figures and 20 tables. Published by Ejnar Munksgaard, Copenhagen, 1949.

Book Reviews[1]

BONE AND JOINT RADIOLOGY. By EMERIK MARKOVITS, M.D., Formerly, Scientific Collaborator of the Central Radiologic Institute of the General Hospital (Holzknecht-Institute), Vienna, Head of the Radiologic Department of Elizabeth Hospital of the City of Budapest, and Post-graduate Lecturer at the Central Radiologic Institute of the University of Budapest; Radiologist of the Steiner Cancer Clinic, Atlanta, Ga. A volume of 446 pages, with 616 illustrations. Published by The Macmillan Co., New York, 1949. Price $20.00.

In this volume on bone and joint pathology as revealed by radiologic study, the author divides the subject matter into two main parts: general and regional. The general discussion opens with a short section on the anatomy, development, and physiology of the skeletal system. A detailed discussion of the various disease processes by which the bones may be involved constitutes a second section, while the third and fourth sections are devoted respectively to diseases affecting the joints and diseases of the muscles and soft tissues. In so far as the subject matter permits, the author has followed a consistent plan of presentation in his discussion of these various disease entities, beginning with a brief account of the pathology, which he follows with a description of the radiologic changes and the local characteristics. The inclusion of synonymous terms applied to a given disease is a helpful feature.

In the chapters on the individual bones and joints, making up Part II, there is usually an opening anatomical description with some reference to the physiology of the part. Sections on ossification of the bone, congenital anomalies, and traumatic lesions are included.

As in other works of the kind, the descriptive matter appears to vary according to the interest of the author. In some instances it is brief to the point of being little more than a summary. In others a rather long description is given. At the end of most of the chapters there is presented in tabular form the differential diagnosis of the various conditions which are discussed. This is a valuable addition which will have a wide appeal.

The extensive illustrative material includes many

[1] In the December 1949 issue of Radiology (p. 877) the author of *Untersuchungen über den lumbalen und cervikalen Wirbelbandscheibenvorfall* should have been given as Dr. F. Reischauer instead of Freischauer. There has also been a change in the price of the book, for which the American distributors should be consulted.

pen and ink sketches. Unfortunately the roentgenographic reproductions are a mixture of positives and negatives, which one finds hard to excuse in a new work such as this. The book is nicely bound and attractive in format. The index appears to be adequate for quick reference. At the end of the volume is a bibliography which will be of value to those seeking source material.

This volume should be a useful addition to the library of both the radiologist and the clinician.

RADIOLOGIC EXPLORATION OF THE BRONCHUS. By S. DI RIENZO, M.D., Assistant Professor of Radiology and Physiotherapy, Chief of the Radiology Department of the Institute of Cancer, The University of Córdoba, Argentina. Translated by Tomas A. Hughes, M.D., with a Foreword by Richard H. Overholt, M.D. A volume of 332 pages, with 466 illustrations. Published by Charles C Thomas, Springfield, Ill., 1949. Price $10.75.

This long-awaited English translation of the first Spanish edition of Di Rienzo's work on the radiologic study of the bronchus is of great importance to students, radiologists, and thoracic surgeons. Too often, as Overholt states in his Foreword to the book, bronchography has been used merely to establish a diagnosis without furnishing the surgeon an exact anatomical basis for planning the extent of the resection in cases referred for operation.

Opening chapters on the embryology and anatomy of the bronchi, well illustrated by numerous roentgenograms, devote special attention to the gross appearance and position of the various segments. The bronchographic characteristics of the normal bronchi are then considered, including a discussion of physiological changes. Of special interest is the description of the cough reflex, showing that the expulsive act of coughing takes place in the bronchial wall, a concept that was brought out in the author's contribution on "Bronchial Dynamism" published recently in RADIOLOGY.

Several chapters are devoted to the bronchographic procedure, covering the preliminary anesthetization, instillation of the oil, and the radiographic technic. A chapter on tomography is also included.

The remainder of the book is devoted to applications of roentgenographic exploration of the bronchi in bronchopulmonary malformations and chronic lung diseases—bronchiectasis, emphysema and asthma, carcinoma, hydatid disease, and pulmonary suppuration. A bibliography is given at the end of each chapter.

The text is abundantly illustrated, the figures being frequently grouped to show the successive phases of filling in a given area. The format is attractive and the binding good. The index appears to be adequate.

Unfortunately the translation is not always into idiomatic English, as for instance the use of the word "expulses" rather than expels, and of "bronchial defile," presumably for bronchial narrowing. The statement that "accidents caused by the contrast substance nearly always occur" would seem, in the light of the following text, to mean actually that accidents, when they do occur, are nearly always due to the contrast medium, which is quite another matter.

ÜBER DIE NEUEN STRAHLENSCHUTZREGELN FÜR DIE HERSTELLUNG UND ERRICHTUNG MEDIZINISCHER RÖNTGENEINRICHTUNGEN UND -ANLAGEN, DIN 6811 UND 6812. By HERBERT GRAF, Chief Engineer, Siemens-Reiniger Works, Erlangen. A monograph of 72 pages. Published by Georg Thieme, Stuttgart, 1949. Distributed by Grune & Stratton, Inc., New York.

This small booklet contains the revision of the first set of safety regulations for the manufacture of x-ray equipment and its installation, introduced in 1933. These revised rules, to meet war conditions, became effective on July 1, 1943. Even though considered only as a wartime measure, they have been kept in effect up to date, because of shortage in critical materials.

DIN 6811 deals with the problems in manufacture of x-ray equipment. It covers maximum doses per day, definitions for tubes and tube-heads, screening off of the direct beam and protection against stray radiation emitted by tube and rectifying valves. Under the section "Special Protective Measures", rules for protection by distance and at the fluorescent screen are given. The final section contains some regulations for the cleaning of x-ray equipment and measures to protect the fluoroscopist examining the tuberculous. Each paragraph is provided with a commentary by the author. These commentaries contain interesting tabulations of data on such problems as lead equivalents for kilovoltages between 50 and 400, for various materials and exposure conditions.

DIN 6812 deals with rules pertaining to the installation of x-ray departments for diagnosis and therapy. Of particular interest is section 4, stating maximum permissible doses as follows: X-ray equipment to be used in diagnosis must be installed in such a manner that on the place provided for the operator the daily dose does not exceed 0.25 r/air. It should be attempted to install the equipment so that doses reaching sex organs do not exceed 0.025 r/air per day. For therapy units the daily dose at the place of the operator should not exceed 0.025 r/air.

IN MEMORIAM

Murray Cass Morrison, M.D., F.F.R.

1896–1949

With the death of Dr. Murray C. Morrison in London, Ontario, on Nov. 27, 1949, Canadian radiology lost one of its outstanding figures. His kindly nature, his high ability, and indefatigable efforts for the good of Canadian radiology made him well known and well loved by all of his confreres.

Dr. Morrison was born on June 14, 1896, at Thamesford, Ontario, the son of Mr. and Mrs. Matthew Morrison. He was educated at the London, Ontario, Collegiate Institute, and at the University of Western Ontario, London, where he obtained his Doctorate of Medicine degree in 1918. Following internship in Victoria Hospital, London, he served in the Canadian Army Medical Corps at home and overseas, following which he was in general practice at Parkhill and later at Thorndale, Ontario, up to the year 1929, at which time he commenced his postgraduate training in radiology at Ann Arbor, Mich., with Drs. P. M. Hickey, C. B. Peirce, and F. J. Hodges.

Dr. Morrison started practice in radiology in London, Ontario, in 1932, where he was appointed Instructor in Radiology at the University of Western Ontario. In August 1937, he became radiologist to St. Joseph's Hospital of that city, as well as conducting his private office practice. He was a member of Alpha Kappa Kappa, medical fraternity, and of Alpha Omega Alpha, honour medical fraternity, of the London Academy of Medicine, of the Harvey Club, and of the Ontario and Canadian Medical Associations. He was a diplomate of the American Board of Radiology and was certified in Diagnostic and Therapeutic Radiology by the Royal College of Physicians and Surgeons of Canada. He was a member of the Radiological Society of North America and of the American College of Radiology, a Fellow of the Faculty of Radiologists of London, England, and a member of the Examining Board of that Faculty, for Canada. He was very active in the affairs of the Canadian Association of Radiologists and was President of the Association for the year 1946–47, in which office he gave outstanding evidence of his ability as an organizer and administrator.

At the time of his death, Dr. Morrison was Professor of Radiology at the University of Western Ontario, the first to attain that rank. He was Director of the Department of Radiology of St. Joseph's Hospital and Consultant Radiologist to the Ontario Hospital, London, the Strathroy General Hospital, the General Hospital at Wingham, Ontario, the Scott Memorial Hospital, Seaforth, and the Clinton General Hospital. He served as Chairman of the Medical Staff at St. Joseph's Hospital for the years 1947–49.

Dr. Morrison had many and diversified interests outside Medicine and Radiology. He was a member of the Masonic Order and of the London Kiwanis Club, a member of the Board of Directors of St. Paul's Cathedral, London, a member of the London Hunt and Country Club, of the London Club, and the London Curling Club.

In 1918 Dr. Morrsion married Marion Elizabeth Bayley, who, with their two daughters, Doris Evelyn (Morrison) Chubb and Marion Virginia Morrison, survive him. He is also survived by a brother, Mr. Roy Morrison of Ottawa and by two sisters, Mrs. Stanley Dick and Mrs. Alex Graff, both of California, U.S.A., to all of whom the deepest sympathy is extended.

In the passing of Dr. Morrison we mourn the loss of an outstanding citizen, a leading radiologist, and an old friend. ARTHUR C. SINGLETON, M.D.

Murray Cass Morrison, M.D., F.F.R.
1896–1949

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Hugh F. Hare, M.D., 605 Commonwealth Ave., Boston 15, Mass.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Philadelphia, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37, Ill.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M. D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Robert L. Ayers, M.D., 726 4th St., Marysville. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. F. Reynolds, M.D., University Hospital, San Francisco 22. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John J. McGuire, M.D., 1117 N. Palafox, Pensacola. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, David Kirsh, M.D., 712 duPont Bldg., Miami 32. Meets monthly, last Wednesday, 8:00 P.M.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Wm. W. Bryan, M.D., 490 Peachtree St., N.E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert Drane, M.D., De Renne Apartments, Savannah. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY, *Secretary*, John H. Gilmore, M.D., 720 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital. Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Harold L. Shinall, M.D., St. Joseph's Hospital, Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*. William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

LOUISVILLE RADIOLOGICAL SOCIETY, *Secretary-Treasurer*, Everett L. Pirkey, Louisville General Hospital, Louisville 2. Meets second Friday of each month at the Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary-Treasurer*, George Belanger, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, C. N. Borman, M.D., 802 Medical Arts Bldg., Minneapolis 2. Meets in Spring and Fall.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Charles J. Nolan, M.D., 737 University Club Bldg. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ralph C. Moore, M.D., Nebraska Methodist Hospital, Omaha 3. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, George Levene, M.D., Massachusetts Memorial Hospitals, Boston. Meets monthly on third Friday at the Harvard Club.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Benjamin Copleman, M.D., 280 Hobart St., Perth Amboy. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., in Kings County Medical Bldg.

NEW YORK ROENTGEN SOCIETY. *Secretary*, F. H. Ghiselin, M.D., 111 E. 76 St., New York.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88-29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Vaughn Winchell, M.D., 40 Meigs St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, Charles Heilman, M.D., 807 Broadway, Fargo.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Paul D. Meyer, M.D., Grant Hospital, Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Seneca Hotel, Columbus.

CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, E. C. Elsey, M.D. Meets last Monday, September to May.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., Cleveland Clinic, Cleveland 6. Meetings at 6:30 P.M. on fourth Monday, October to April, inclusive.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. E. Brown, M.D., 21st and Xanthus, Tulsa 4. Meets in October, January, and May.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Selma Hyman, M.D., University of Oregon Medical School, Portland. Meets monthly, on the second Wednesday, at 8:00 P.M., in the library of the University of Oregon Medical School.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., 1930 Chestnut St., Philadelphia 9. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets second Wednesday of each month at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston 16.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets during Annual Session of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. Meetings second Tuesday of each month at University Center.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frére, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON X-RAY CLUB. *Secretary*, Curtis H. Burge, M.D., 3020 San Jacinto, Houston 4. Meetings fourth Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Feb. 3–4, 1950, in Dallas.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Walker, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

RADIOLOGICAL SECTION OF THE WISCONSIN STATE MEDICAL SOCIETY. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee. Two-day meeting in May; one-day with State Medical Society, September.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, E. M. Crawford, M.D. Associate Honorary Secretary-Treasurer, Jean Bouchard, M.D. *Central Office*, 1535 Sherbrooke St., West, Montreal 26, Quebec. Meetings in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origéne Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPIA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPIA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Musculoskeletal System

Gynecology and Obstetrics

The Genito-Urinary System

Apparatus and Technic

RADIOTHERAPY

RADIOISOTOPES

EFFECTS OF IRRADIATION

THE HEAD AND NECK

Convolutional Markings in the Skull Roentgenograms of Patients with Headache. Leo M. Davidoff and Harvey Gass. Am. J. Roentgenol. **61:** 317–323, March 1949.

In a report from the Department of Neurological Surgery, Montefiore Hospital, and the College of Physicians and Surgeons, New York, the authors give an analysis of 100 consecutive roentgen examinations of the skull made on patients complaining of headache, comparing the findings with a control group of 100 completely healthy subjects who did not suffer from headache. The age and sex distribution of the two groups was equal. The films were studied for the presence of convolutional markings. When present, these were graded 1 (minimal) to 4 (maximal).

Results of the study show two points of particular interest and value: first, that convolutional markings are quite commonly present in adults (45 to 46 per cent) and, second, that they occur just as frequently in healthy adults without headache as they do in adults who suffer from headaches but are otherwise healthy. Of interest, also, is the high incidence of convolutional markings in females as compared to males in the third through the fifth decades of life, the ratio being nearly 2:1.

Slight degrees of convolutional markings in individuals in the third, fourth, and fifth decades of life may be without pathological significance in half of the skull roentgenograms taken in females and in a third of those taken in males. More severe markings may be present without significance in about 15 per cent of skull roentgenograms taken in all patients in these age groups.

Four tables; 3 graphs; 1 roentgenogram.

RICHARD A. ELMER, M.D.
Cleveland City Hospital

Lacuna Skull and Craniofenestria. C. van Waalwijk van Doorn and J. N. Boet. Am. J. Dis. Child. **77:** 315–327, March 1949.

The authors make a distinction between lacuna skull and "craniofenestria." Lacuna skull is characterized by congenital bony defects restricted to the diploe and inner table. In craniofenestria the outer table is also deficient and cranial contents may protrude through the defects, producing so-called multiple encephaloceles. There is frequently an associated spina bifida, said usually to lie in the thoracic area. Vogt and Wyatt (Radiology **36:** 147, 1941) found that 43 per cent of 120 infants with meningocele had lacuna skull or craniofenestria as compared with an incidence of only 0.04 per cent in a series without meningocele. The authors report 5 cases of associated craniofenestria and spina bifida seen in the pediatric clinic of the Binnengasthuis in Amsterdam.

The most characteristic roentgen sign of both lacuna skull and craniofenestria is the presence of multiple areas of diminished density bounded by bony ridges, especially in the parietal area. The boundaries are sharper in craniofenestria and the contrast in structure more pronounced than in lacuna skull. The prognosis in the presence of meningocele is poor.

The theories assumed to explain this condition fall into three groups. One is the presence of increased intracranial pressure during intrauterine life. The authors discount this theory because in their cases there was no parallelism between the degree of bony change and the intracranial pressure. Also, this condition is rare in cases with increased intracranial pressure but without the compensation of a spina bifida.

The second theory suggests a disorder of development. The authors subscribe to this belief, pointing out that it is favored by the frequent association with spina bifida and citing Rothbart's observation of developmental disturbance of the cerebellum in cases studied histologically (Am. J. Dis. Child. **52:** 1375, 1936).

The third theory suggests that some other disease, such as rickets, is responsible. This has been excluded by Wieland (Virchows Arch. f. path. Anat. **197:** 167, 1909) on histologic evidence.

The authors make one new suggestion. Since there is no mention of this entity in the Netherlands literature prior to World War II, and the infants in this series were conceived shortly after the war, the deficient diet of the mothers may have been an etiological factor.

Three roentgenograms and four photographs.

ALBERT R. BENNETT, M.D.
Mount Sinai Hospital of Cleveland

Endocrinopathies Associated with Hyperostosis Frontalis Interna. Floyd E. Harding. Am. J. Med. **6:** 329–335, March 1949.

The findings in 17 women with roentgenologically confirmed hyperostosis frontalis interna are presented. Evidence of some endocrine abnormality was frequently found but was possibly coincidental. The endocrine conditions encountered included: diabetes mellitus, 2 cases; myxedema, 1 case; non-toxic goiter, 1 case; hyperthyroidism (prior to thyroidectomy), 1 case; secondary amenorrhea, 2 cases; menopause following radium therapy, 1 case; menopause following x-ray therapy, 1 case; climacteric, 2 cases; surgical menopause, 4 cases; sterility (anovulatory), 2 cases; bilateral cystic ovaries (surgical diagnosis during appendectomy), 1 case. In addition, there were 2 cases of probable hypothyroidism and 1 case of possible hypothyroidism. The women showed a great similarity of body build. Most of them were psychoneurotics and had had nervous breakdowns. Frontal headache, asthenia, forgetfulness, vertigo, nervousness, obesity, and poor vision were rather characteristic of the group.

No cause was found for hyperostosis frontalis interna, which is limited almost entirely to the adult female. Some of the symptoms are probably due to cerebral atrophy.

Hormonal, dietary, and symptomatic treatment of the associated conditions is discussed. No effective treatment is known for the hyperostosis.

Four roentgenograms; 4 photographs; 3 tables.

Primary Hemangioma of the Skull: A Rare Cranial Tumor. Review of the Literature and Report of a Case, with Special Reference to the Roentgenographic Appearances. B. D. Wyke. Am. J. Roentgenol. **61:** 302–316, March 1949.

Hemangiomata are rare skeletal tumors, constituting only 0.7 per cent of osseous neoplasms. Primary he-

mangioma of the skull has been calculated to account for 0.2 per cent of all neoplasms of bone, and 10 per cent of primary benign neoplasms of the skull. In an endeavor to clarify the historical background, the author has carefully searched the literature for the last one hundred years and listed in a table details of the 60 cases of cranial hemangiomata, primary or otherwise, which he found.

Primary hemangioma of the skull is most frequent in the fourth decade and is three times as common in females as in males. The parietal bones are most often involved, and the frontal bones next in frequency. The diagnosis depends upon recognition of the characteristic roentgenologic features. In direct (*en face*) views these are (1) a circumscribed, oval, rarefied area, usually in the parietal or frontal regions, (2) a "honeycomb" appearance in the rarefied area, and (3) absence of reactive sclerosis or vascular changes in the skull. In profile views the findings are (1) radial striations, producing a "sun-ray" appearance, (2) erosion of the external table, with expansion more marked externally than internally, (3) preservation of the integrity of the inner table of the skull, and (4) absence of reactive hyperostosis. Macroscopically, as seen at operation, the hemangioma appears as a hard, blue-domed lump on the skull beneath the pericranium. Microscopically it may be of either the capillary or cavernous type, but the former is rare.

Treatment for the accessible tumors is surgical removal. Irradiation may be used in hemangiomas involving the petrous bone.

A case of hemangioma of the frontal bone is reported, with roentgenographic findings, and treatment by block resection and replacement by iliac graft.

Five roentgenograms; 3 photographs; 1 photomicrograph; 3 tables. HARRY HAUSER, M.D.
Cleveland City Hospital

Subarachnoid Hemorrhage. Harold C. Voris. Illinois M. J. **95:** 160–167, March 1949.

Of interest to radiologists are the cranial arteriograms in this paper. The author concludes that spontaneous subarachnoid hemorrhage is a serious condition with an unfavorable prognosis; that, even if the patient survives the initial attack, the danger from further episodes of hemorrhage is great; that cerebral angiography is as indispensable in the diagnosis and exact localization of the responsible lesion as spinal puncture is in the initial diagnosis of the presence of subarachnoid hemorrhage; that the roentgenographic visualization of the causative lesion makes definitive treatment possible in many cases.

Six cases are reported in detail, with angiograms from 4 of the number. The reproductions are of fair quality.
S. F. THOMAS, M.D.
Palo Alto, Calif.

Paraphysial Cysts of the Third Ventricle, with Report of Eight Cases. James Greenwood, Jr. J. Neurosurg. **6:** 153–159, March 1949.

Due to its fragile attachments, the paraphysial cyst is particularly amenable to surgery. Its gross appearance is characteristic and, when looking into the lateral ventricle, one can nearly always see the tumor presenting at the foramen of Monroe. Five cases operated on by the author and 3 additional autopsy cases are reported. In connection with the latter, the need for emergency ventriculography in cases of sudden coma where there is no evidence of infection, diabetes, or nephritis, is emphasized.

The neurological symptoms of paraphysial cysts are meager and seldom sufficient for diagnosis. A peculiar type of organic mental reaction, however, occurred in each of the 5 operated cases, consisting in varying degrees of disorientation, particularly for time and place, while the patient superficially appeared to be alert and mentally normal. It is similar to Korsakoff's psychosis in that the patient fills in his memory defects with confabulation. In all cases, this feature cleared up within two to three months after operation.

Radiologically, ventriculography usually demonstrates absence of free communication between the lateral ventricles. The ventricles are dilated and the septum pellucidum is often deviated. With the patient supine and with the head hyperextended, a lateral view will show the anterior part of the third ventricle in the shape of a sickle, thus outlining the anterior border of the tumor.

Surgery and operative results are briefly discussed.

Seven illustrations, including three roentgenograms; 1 table. H. J. PERLBERG JR., M.D.
New York, N. Y.

Angiographic Studies of the Cerebral Vessels in Arteriovenous Aneurysms. R. Bunner. Acta radiol. **31:** 233–239, March 31, 1949.

Cerebral arteriovenous aneurysm is diagnosed with certainty only through angiography. As a result of decreased peripheral resistance in the aneurysm, the blood stream and thus, also, the injected contrast medium, will to a large extent pass through the aneurysm, while the rest of the branches of the cerebral vessels will be incompletely filled.

Some 75 arteriovenous aneurysms have been established by cerebral angiography in the Serafimer Hospital at Stockholm. More recently 16 cases have been studied by this procedure after extirpation of the aneurysm. Dilatation of the feeding arteries is demonstrable in most cases of arteriovenous aneurysm, extending in retrograde direction as far as the carotid siphon. Within two weeks of operation it was noted that in all cases this dilatation had diminished noticeably or had completely regressed, and that the remaining cerebral vessels filled well, indicating that the dilatation is secondary to the aneurysm.

With a single exception, in a patient with a history of rheumatic disease, cardiac enlargement was not observed in any of the cases in which roentgen examination of the heart was done. This supports Reid's observation that congenital arteriovenous aneurysms do not produce such an effect, and that acquired arteriovenous aneurysms do so only if the feeding artery dilatation extends all the way back to the heart.

Eight angiograms. J. A. CAMPBELL, M.D
Indiana University

Verified Cerebral Aneurysm with Negative Arteriogram. Bernard J. Alpers and James J. Ryan. J. Nerv. & Ment. Dis. **109:** 220–225, March 1949.

Relatively typical clinical findings of aneurysm involving the cerebral arteries are: (1) recurrent unilateral head pain, often frontal or supra-orbital and (2) progressive or acute cranial nerve paralysis often involving one or more of the oculomotor nuclei. The authors feel that the presence of this picture is so char-

acteristic that exploration is justified. This line of reasoning led to the discovery of two cases of aneurysm of the internal carotid artery in which the intracranial arteriograms were negative. Both aneurysms were large. No explanation for failure to demonstrate them was apparent.

Two arteriograms. R. M. GEIST, JR., M.D.
Cleveland Clinic

Paradental Autonomous Osseous Nucleus in the Maxilla. Edmund Ingber. Radiol. clin. **18:** 1–12, January 1949. (In German)

A case is reported of a benign tumor of the jaw examined roentgenologically and histologically. The author designates it as a "displaced paradental autonomous osseous nucleus" and believes it to be the first such case in the literature. It had been interpreted erroneously as "displaced dental anlage" and "cyst enclosing a dental root stump." Removal of the mass cured a prolonged and annoying migraine.

Seventeen illustrations including roentgenograms.
HANS A. JARRE, M.D.
Detroit, Mich.

THE CHEST

Perceptibility of Details in Roentgen Examinations of the Lung. G. C. E. Burger. Acta radiol. **31:** 193–222, March 31, 1949.

The roentgen image is produced by a complicated process. Formerly the quality of different roentgen pictures and technics has been estimated only in a qualitative and very subjective way. Now that mass-survey methods are being used, an accurate objective method of determining the best technics is vital.

With the use of a phantom built up of bakelite plates it was demonstrated that a relatively slight improvement in the resolving power, or perceptibility of details, reduces reading time and errors of interpretation.

A phantom is also described for obtaining a constant quality in serial chest films on the same patient. This "quality-control phantom" is composed of aluminum steps and bakelite balls and can be used in an upper corner of the chest film. In any case of difference between two pictures of the same patient one can determine with its use to what degree the difference is due to changes in the patient and to what degree to technical factors.

Unsharpness of the screen is one of the most important detrimental factors in fluoroscopy of the lung. A method involving the use of a "star phantom" is described for estimation of this factor.

Thirty illustrations.
O. RAYMOND RUSSELL, M.D.
Indiana University

Routine Fluororoentgen Chest Examinations of Hospital Admissions from the Viewpoint of the Radiologist. Abraham Melamed and Alan Fidler. Dis. of Chest **15:** 346–353, March 1949.

The authors relate their experience with fluororoentgen examination of the chests of 3,626 persons admitted to the Evangelical Deaconess Hospital in Milwaukee, from July 1, 1947, to March 15, 1948, representing 77.8 per cent of all admissions for that period. They favor the use of 4 × 5-inch stereo films. Their findings are listed as follows:

Negative, 2,591 cases, or 71.4 per cent.
Abnormal findings of little or no clinical significance, 667 cases, or 18.4 per cent.
Abnormal and pathological findings warranting further study on large films, 342 cases, or 9.4 per cent.
Positive pathological findings, requiring no further study, 26 cases, or 0.8 per cent.

Of the abnormal and pathological findings, 46, or 1.25 per cent, were diagnosed as tuberculosis; 3 active and 43 inactive. About 8 per cent represented cardiovascular lesions.

The authors recommend screening of all hospital admissions by the fluororoentgen method. They stress the fact that a well planned, carefully supervised program is mandatory if the procedure is not to be discredited.

Three tables. HENRY K. TAYLOR, M.D.
New York, N. Y.

Tuberculosis Studies in Muscogee County, Georgia. I. Community-wide Tuberculosis Research. George W. Comstock. Pub. Health Rep. **64:** 259–263, March 4, 1949. **II. X-Ray Findings in a Community-wide Survey and Its Coverage as Determined by a Population Census.** M. H. Burke, H. C. Schenck, and J. A. Thrash. Ibid., pp. 263–290.

An ambitious attempt was made to survey an entire county in west central Georgia to provide a basis for a long-term project for the study of the epidemiology of tuberculosis. The survey was followed by a population census to determine what percentage of the population had been covered.

Seventy-millimeter film was used. All films were read by two chest physicians, and persons with a reading, by either of these, of "tuberculosis" or "suspected tuberculosis" were recalled for examination with 14 × 17-inch films. About the same percentage of tuberculosis was found as in other mass surveys in comparable groups, so that, as the project continues, the information will be applicable generally.

One interesting table analyzes the reasons given by 2,369 individuals for failing to accept x-ray examination during the survey. These were obtained in the course of the census.

Twelve tables; 4 graphs; 4 maps.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radiological Images Which Simulate Pulmonary Tuberculosis in Children. José M. Mir. Rev. cubana pediat. **21:** 123–143, March 1949. (In Spanish)

The author explains that his discussion covers both primary pulmonary tuberculosis and reinfection, as these are encountered with the same frequency in his service devoted to children between four and fourteen years. He believes that there are no radiological findings pathognomonic of pulmonary tuberculosis. The diagnosis in children is at times very difficult. It should be based on a series of factors, such as antecedents, clinical symptomatology, physical examination, the hemocytogram, erythrosedimentation test, x-ray examination, tuberculin test, bacteriologic study, and the evolution of the case. The examination should be as much clinical as radiological. None of the factors should be taken alone, not even a positive bacteriological test. It is the association of all, considered to-

gether, and carefully evaluated, which will give the diagnosis.

Among the confusing roentgen findings simulating infantile pulmonary tuberculosis, the author mentions pulmonary abscess; atelectasis and other primary alterations due to asthma; congenital heart disease; staphylococcic infection which may simulate a primary infection; Hodgkin's disease; ordinary pneumonia; acute bronchopneumonia; pseudo-cystic pulmonary blebs, simulating pulmonary cavities; and chronic pneumonitis. Illustrative cases of these various conditions are included.

Thirteen roentgenograms.

JAMES T. CASE, M.D.
Chicago, Ill.

Pulmonary Hazard of the Ingestion of Mineral Oil in the Apparently Healthy Adult. A Clinicoroentgenologic Study, with a Report of Five Cases. Louis Schneider. New England J. Med. **240:** 284–291, Feb. 24, 1949.

This discussion of lipid pneumonia is based upon the study of 5 cases in which the diagnosis was made during life. All of these patients had used mineral oil as a laxative over a long period. In 2 there was an absence of gag reflex, which may account for the entry of the oil into the lung. Symptoms of this condition are mild, considering the extensive disease so often found. Suppuration or bronchiectasis is seldom present but the patient may be susceptible to frequent pneumonias. Dyspnea on exertion and hacking cough may be present. The general health is usually good, and physical signs of disease are absent.

Some of these cases have been discovered on routine chest examinations showing extensive x-ray changes. The oil is usually found in the basal areas of the lung, where infiltrative processes are seen, often bilateral. Atelectasis is rarely present, nor is hilar adenopathy seen. On fluoroscopy, the diaphragm moves freely unless there is secondary infection. The heart and mediastinum usually appear normal.

A lipid pneumonia must be differentiated from a neoplasm, bronchiectasis, pneumonia, and tuberculosis. If the condition is suspected, the diagnosis may be made by finding oil droplets in the sputum or on aspiration biopsy.

Treatment consists in cessation of the ingestion of oil. Surgical removal of the involved area may be considered in some cases.

Five case reports are presented, with 8 roentgenograms.

JOHN B. MCANENY, M.D.
Johnstown, Penna.

Pulmonary Actinomycosis. S. F. Oosthuizen and M. H. Fainsinger. Brit. J. Radiol. **22:** 152–155, March 1949.

Actinomyces were first identified by Harz in 1877 in the discharge from lesions of the tongue and jaws of cattle. Actinomycosis is seen rarely in man. Infection may occur through abrasions of the skin or mucous membranes or by inhalation. Pulmonary actinomycosis may be primary or secondary to mediastinal infection.

The pulmonary disease may be symptomless or may be accompanied by slight cough and mild chest pain. Signs of consolidation or pleural effusion may be elicited. Later abscess of the chest wall may develop. The diagnosis depends upon finding the characteristic sulfur granules in the sputum. The roentgen appearances are not typical. There may be consolidation, abscess formation, or pleural effusion.

Three probable cases of primary thoracic actinomycosis are reported. The first showed a lung abscess of peculiar type, which suggested the diagnosis; the second showed multiple abscesses, prominent lung markings and dilated bronchi, with an abundantly positive sputum; and the third, a mediastinal effusion. In the last case, the nature of the lesion was not suspected until the aspirated fluid was examined under the microscope. All 3 cases showed a favorable response to treatment by penicillin.

Three roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Acute Idiopathic Pulmonary Haemosiderosis. Leslie Nancekievill. Brit. M. J. **1:** 431–433, March 12, 1949.

The case of a girl two and a half years old who died of acute idiopathic pulmonary hemosiderosis is described in detail. The illness was of about six weeks duration and was characterized by increasing pallor, lassitude, general debility, and severe hypochromic anemia. Symptoms were markedly relieved by administration of appropriately selected packed cells, but only for a few days. Serial chest roentgenograms showed increasing reticulation of the lung fields, maximal in the hilar areas and diminishing in the periphery. Death was due to asphyxia.

Autopsy showed gross changes in the lungs and pleura: multiple subpleural petechial hemorrhages, a small effusion, and recent pleural roughness. The iron content of the lungs was greatly increased as demonstrated by assay. The remaining organs showed no evidence of a hemolytic process. No irrefutable evidence of deficiency in the structure of the pulmonary vessels or supporting alveolar framework was shown.

The question is raised whether periodical increases in the pulmonary arterial pressure of unknown cause might operate during the development of the idiopathic case of this condition.

Two roentgenograms; 1 photomicrograph.

ALTON S. HANSEN, M.D.
Peoria, Ill.

Q Fever—A Review of Current Knowledge. Robert J. Huebner, William L. Jellison, and M. Dorothy Beck. Ann. Int. Med. **30:** 495–509, March 1949.

As indicated by the title, this paper is in the nature of a review, based on the numerous reports of Q fever, beginning with the description of the first cases in Australia (Derrick: M. J. Australia **2:** 281, 1937). All phases of the disease are discussed and a bibliography of sixty references is appended.

Q fever presents a fairly constant clinical syndrome, characterized by sudden onset, fever with relative bradycardia, headache, weakness, malaise, chilly sensations, drenching sweats, and considerable variation in duration and severity. A pneumonitis is revealed in the majority of cases examined roentgenologically and is attended by mild cough, scanty expectoration, chest pain, and minimal physical findings.

The lung lesions as seen on the roentgenogram may be single or multiple. They usually consist of irregularly shaped patches of increased density, sometimes

described as resembling ground glass. They tend to occur in the peribronchial and alveolar rather than the hilar regions, and more often than not are found in the lower lobes. They occasionally clear rapidly, but more frequently resolution is slow, roentgen evidence often persisting after the patient returns to normal activities. Q fever is not, however, to be classified simply as a pneumonitis. It is a systemic disease of rickettsial etiology and may produce serious illness with no evidence of pneumonitis demonstrable at any time.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

Transitory Pulmonary Infiltration (Loeffler's Syndrome). F. T. Roque. J. Philippine M. A. **25:** 119–123, March 1949.

Three cases of Loeffler's syndrome in Filipino patients are reported. All were originally diagnosed as tuberculosis.

Disseminated Ossification of the Lungs in Association with Mitral Stenosis. H. M. Lawson. Brit. M. J. **1:** 433–434, March 12, 1949.

Two types of heterotopic ossification in the lungs are found: (*a*) trabecular, a senile change in the interstitium; (*b*) nodular circumscribed, found in younger persons suffering from mitral disease, associated in most cases with chronic passive congestion. Fewer than 40 such cases have been reported.

The author's case is that of a woman, aged 39, who for nine years had suffered with exertional dyspnea. During her hospital stay of twenty-eight days, at the end of which time she died, the principal features of her disease were those of cardiac failure and pneumonia. Roentgenograms of the chest demonstrated generalized miliary shadows 0.5 to 2.0 mm. in diameter, in addition to congestion in both middle zones and cardiac enlargement.

Autopsy showed, in addition to cardiac and pulmonary changes, studding of the pleurae with miliary calcified plaques 1 to 2 mm. in diameter. Microscopically, numerous rounded nodules of bone were found in the lung substance many, showing a calcified center with peripheral additions of osteoid tissue. Vessels were present in the bone but no medullary cavities.

It is suggested that the bone may arise from organization of congestive hemorrhages or from intra-alveolar collections of pigment-bearing phagocytes.

One roentgenogram; 1 photomicrograph.

ALTON S. HANSEN, M.D.
Peoria, Ill.

Tomographic Demonstration of Broncholiths. Ernst Theilkäs. Radiol. clin. **18:** 13–17, January 1949. (In German)

In a patient with moderately advanced bilateral, chronic, productive tuberculosis, with limited left-sided excavation, three concretions in the lumen of the left bronchus were demonstrated by laminagraphy.

Two roentgenograms. HANS A. JARRE, M.D.
Detroit, Mich.

Roentgenkymographic Study of the Pulmonary Circulation. Ayres de Sousa, Lopo de Carvalho, and Carlos Vidal. Radiol. clin. **18:** 18–30, January 1949. (In German)

Roentgenkymographic study of the pulmonary circulation in rabbits furnished reliable data concerning the pulmonary circulation time of contrast fluid. The method proved to be simpler and much less expensive than roentgencinematography. It allowed simultaneous registration of certain dynamics of the heart and respiration.

The authors used a single-slit plane kymograph with moving film, at 55 kv. and 110 ma., over periods ranging from eight to fifteen seconds, at 80 cm. film focal distance. Contrast fluid was injected through a catheter introduced into the jugular vein.

Nine illustrations, including roentgenograms.

HANS A. JARRE, M.D.
Detroit, Mich.

Diagnostic Problem of Primary Pleural Effusions. Joseph R. Kraft. Am. Rev. Tuberc. **59:** 259–269, March 1949.

This report deals with a study of 100 patients with serous pleural effusion observed on the tuberculosis service of the Fitzsimons General Hospital in Denver, The cases were classified into three groups. Group I consisted of 55 cases without evidence of pulmonary lesions or abnormal laboratory findings. Group II consisted of 24 cases without evidence of pulmonary disease but with bacteriologic evidence of tuberculosis. Group III consisted of 21 cases in which evidence of pulmonary disease was detected after the appearance of the effusion. The essential data on these cases are presented in a series of six tables.

Of the 100 patients in the series, 24 were originally considered to have non-tuberculous disease. The diagnosis of atypical pneumonia with effusion was the most frequent error. It was found impossible to foretell which infections might progress to the development of parenchymal or other lesions. Thus treatment must be initiated empirically. It is believed that at least one year of good sanitarium care is the minimum advisable for the patient with primary pleural effusion.

The insidious onset of subjective symptoms was frequent in this series. Seventy-seven per cent of the patients had symptoms for seven or more days prior to seeking medical attention. In 10 cases the effusion was first detected on a routine roentgenographic examination.

L. W. PAUL, M.D.
University of Wisconsin

Mediastinal Lipoma with Inclusion of Remnants of Thymus Gland. Paul W. Schanher, Jr., and G. B Hodge. Am. J. Surg. **77:** 376–379, March 1949.

A case of mediastinal lipoma with inclusion of remnants of the thymus gland is reported. The tumor was demonstrated roentgenologically and the diagnosis proved microscopically.

Roentgen examination of the chest usually shows a well defined mass that may limit itself to the mediastinum. However, the entire pleural cavity may be occupied. The true nature of the mass may be suspected from the homogeneous density, with the periphery less opaque.

Four roentgenograms; 2 photographs.

Starling's Law and X-Ray Density Changes of Heart Shadow. Gordon C. Ring, Catherine R. Michie, and M. J. Oppenheimer. Am. J. Physiol. **156:** 339–344, March 1, 1949.

A method utilizing electrokymography is described which, it is believed, will record rapid changes in the

size of the heart within the intact chest. This method has been used to show that in the intact animal the heart follows Starling's law (the energy of contraction is a function of the length of muscle fibers) during the period after vagal stimulation. Under epinephrine, the heart responds to a given load of work with less dilatation than under control conditions.

Four illustrations, including one roentgenkymograph.

Dysphagia and Mitral Valve Deformity. Abraham Gootnick. Ann. Int. Med. **30:** 662–668, March 1949.

Considering the frequency with which appreciable compression of the esophagus is encountered during fluoroscopic examinations of patients with mitral stenosis, it seems surprising that symptomatic impediment to swallowing is so rare. The elasticity of the normal esophagus, its relationship to non-rigid structures on either side, and its consequent motility appear to be the protective factors which permit considerable encroachment by the left auricle without the development of functional occlusion.

In the case reported, that of a 55-year-old Negro male, fluoroscopy revealed an enormously enlarged heart with the left ventricle and left auricle particularly prominent. The right oblique view showed the left auricle bulging backward to occupy the entire width of the retrocardiac space. The middle third of the esophagus was compressed and markedly narrowed; there was definite hesitancy of the barium at the upper border of compression. Systolic pulsation of the left auricular outline could be seen with each ventricular contraction. Reconstruction of the story of the patient's illness led to the diagnosis of rheumatic heart disease, inactive, with enlarged heart and mitral insufficiency and stenosis, with the insufficiency preponderant. It appeared that congestive failure had complicated an initial acute respiratory infection.

Appropriate treatment for correction of the failure met with immediate response. The patient was soon able to swallow freely, and further fluoroscopic study showed reduction in the size of the left ventricle and auricle; the barium swallow was unimpeded and ventricular pulses were no longer transmitted to the left auricle.

Seven other cases of left auricular enlargement with dysphagia were found in the literature. In these, as in the case recorded here, the left ventricle was massively enlarged, insufficiency or incompetence of the mitral valve was a prominent feature, and congestive failure occurred in varying degree. In these cases, also, diminution in the size of the left auricle and relief of dysphagia proceeded parallel with correction of failure and reduction in the size of the left ventricle. In view of such observations, it is believed that the significant change in these cases is marked dilatation of the failing left ventricle with increasing reflux into the left auricle through an incompetent mitral valve, the auricular dilatation representing a compensatory mechanism in response to increased intra-auricular pressure. The mitral stenosis found in all the reported cases is therefore to be more accurately regarded as an incidental part of rheumatic valve scarring and not as the sole causative mechanism of extreme left auricular enlargement. Such enlargement is due rather to the superimposed stress of a widely incompetent mitral valve developing with far-advanced left ventricular dilatation.

It is suggested that, in addition to the two common explanations of vomiting during congestive failure, *i.e.*, congestion of the portal circulation and digitalis intoxication, a third mechanism may occasionally be involved, namely, compression of the esophagus by an excessively enlarged left auricle.

Five roentgenograms.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

THE DIGESTIVE SYSTEM

Lymphosarcoma of the Gastrointestinal Tract, with a Report of Twenty-One Cases. M. A. Spellberg and Simon Zivin. Arch. Int. Med. **83:** 135–149, February 1949.

In the fifteen-year period 1931 to 1946, 11 cases of primary gastric lymphosarcoma and 960 cases of carcinoma of the stomach were seen by the authors. This is a ratio of 1 lymphosarcoma to 88 carcinomas, which is in fairly close accord with other reported series. The ages of the patients with lymphosarcoma varied from twenty-six to fifty-seven years; 6 were below fifty, bearing out the observation of others that lymphosarcoma occurs in younger persons than does carcinoma.

The symptoms in gastric lymphosarcoma were found to be no more diagnostic than in carcinoma. Their duration before a diagnosis was made ranged from three months to twenty-four years.

In 5 of the 11 cases of lymphosarcoma an epigastric mass was palpable. In 4 physical findings were noncontributory except for evidence of loss of weight or of anemia. Manifestations of bleeding were common in this series. Hematemesis alone was seen three times, hematemesis and melena twice, and melena alone twice. In only 3 instances did the stools contain no blood. Anemia was a common finding but not as common as the occult blood in the stools. There was a surprising lack of correlation between these two findings. Gastric acidity was on the lower side of normal. In 2 patients there was no free hydrochloric acid on gastric aspiration.

In 1 case the roentgenologist made a diagnosis of lymphosarcoma. A smooth, extensive filling defect was seen on the greater curvature of the stomach and there were no ulcerations or significant involvement of the mucosa. The opinion that a lymphosarcoma was present was based on the lack of mucosal involvement despite the size of the tumor. In a second case the roentgen findings were suggestive enough to warrant the opinion that the appearance was consistent with lymphosarcoma. In this case there was narrowing and loss of pliability of the prepyloric region, with intact rugal folds. In 5 cases the roentgenologic diagnosis was carcinoma and in 2 others the lesion was referred to simply as a neoplasm. No diagnosis was rendered in 1 case because the roentgen findings were so bizarre. It appeared to the fluoroscopist that the barium was leaving the gastric cavity through an opening in the greater curvature and entering an irregular cavity, perhaps the lesser peritoneal sac. Actually, the stomach was deformed by the tremendous neoplasm, with a shelf-like structure in its center which appeared to divide the organ into two irregular cavities. Gastroscopy was performed in this one case only and a diagnosis of lymphosarcoma was hazarded; at autopsy this proved to be correct.

In 8 of the 11 cases the mass was located along the greater curvature. In 8 cases the perigastric lymph

nodes were involved. In 5 instances the tumor was of the small-cell type, the malignant lymphoma; in 5 others it was of the large-cell variety, or the reticulum-cell type. In 1 case the cell type was undetermined.

Four patients in this series underwent gastric resection and irradiation, with an average survival of 46.6 months (six months, two years, six years, seven years, respectively). For the 7 patients who received irradiation alone, the average survival period was only 18.5 months (1 five years; 2 over two years; 4 less than one year). This cannot be accepted as evidence that irradiation therapy alone is inferior to combined treatment, however, since the condition of the patients not treated surgically was far advanced and inoperable. In the 5 cases in which the tumor was of the small-cell type the average length of survival was forty-four months, while in the cases in which it was of the reticulum-cell type the average was only seven months.

During this same period, 1931 to 1946, 10 cases of localized intestinal lymphosarcoma were observed, 5 in the large intestine and 5 in the small intestine. In the latter, the commonest site of the tumor was the ileum. The ratio of patients with carcinoma of the colon (from cecum to anus) to those with lymphosarcoma was 1:300.

The symptomatology varied somewhat according to the site of the lesion but was not diagnostic in any of the cases. The outstanding physical finding, and the one which emphasized the presence of a neoplasm, was an intra-abdominal mass, palpable in some portion of the abdomen in all but 2 cases. It is stressed that a mass becomes palpable early in lymphosarcoma; in several instances symptoms had been present for only two months.

The roentgenographic diagnosis was entirely erroneous in 3 cases. In 1 of the remaining cases the deformity of the cecum was considered to be due to extrinsic pressure, which it might well have been, since in addition to the cecal involvement there was also ileal involvement. One case of cecal lymphosarcoma was diagnosed as carcinoma. In another case, in which involvement of the descending colon was present, no pathologic changes were seen during the first examination, but six weeks later a flat plate of the abdomen revealed gaseous distention of the bowel down to the middle of the descending colon. The diagnosis was an obstructive lesion at that point. In 1 case, involvement of the transverse colon, which was thought to be neoplastic or inflammatory, was reported; the lesion, however, was actually in the jejunum, ileum, and ascending colon. In a case in which there was involvement of the ileum and jejunum, there was roentgen evidence of partial intestinal obstruction; no suggestion was ventured by the roentgenologist as to the origin of the obstruction.

The prognosis in intestinal lymphosarcoma is extremely poor. No patient in the present series survived five years. Most died in less than six months.

Five roentgenograms; 4 tables.

Prolapse of Gastric Mucosa into the Duodenum. Case Report and Analysis of Reported Cases. J. L. DiLeo, L. H. Kuker, and R. M. Shepard. New Orleans M. & S. J. **101**: 428–435, March 1949.

The authors were able to find in the literature only 33 cases of prolapsed gastric mucosa proved by operation, to which they add one more. Many cases are misinterpreted by the roentgenologist as pyloric hypertrophy or are overlooked entirely. Also, only a few surgeons appear to be willing to operate for this condition even when the diagnosis is made.

The underlying condition is probably a localized gastritis with redundancy of the mucosa which is finally forced by peristalsis through the pylorus.

The symptoms vary, but consistent complaints are epigastric distress aggravated by solid food, epigastric fullness, nausea, and vomiting. As might be expected, bleeding may occur.

The x-ray appearance is typical—a mushroom-type filling defect in the base of the cap, into which the gastric rugae may be traced. Pyloric obstruction may be noted in severe cases.

Surgical procedures vary from simple excision of the redundant mucosa to pyloroplasty and gastric resection. Surgeons unfamiliar with the condition must be cautioned to open the stomach even though palpation and external inspection are entirely negative.

Two roentgenograms; 6 tables, 1 of which includes details of the 33 previously reported cases.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radiographic Studies Showing the Induction of a Segmentation Pattern in the Small Intestine in Normal Human Subjects. A. C. Frazer, J. M. French, and M. D. Thompson. Brit. J. Radiol. **22**: 123–136, March 1949.

In the course of studies on defective fat absorption, attempts were made in normal human subjects to produce the "deficiency pattern," segmentation of barium and obliteration of the normal small intestinal mucosal pattern. The contrast medium used was barium sulfate in water: for oral administration 60 gm. in 300 c.c., and for intraduodenal instillation 30 gm. in 100 c.c. Various substances were added on occasion to find out what would alter the normal pattern.

Examinations were made at five, fifteen, thirty, sixty, and one hundred and twenty minutes. When barium sulfate and water alone were used, a normal pattern was always obtained throughout the series on each subject.

Isotonic solutions of sodium chloride, sodium bicarbonate, and glucose, when introduced with the barium suspension, caused no significant change in the pattern. Hypertonic solutions, however, 7 per cent sodium chloride, 10 per cent sodium bicarbonate, and 40 per cent glucose, caused marked segmentation, the pattern being identical with the "deficiency pattern" seen in cases of sprue.

Hydrochloric acid, 0.1 or 0.3 per cent, caused no change; 0.3 per cent acetic acid and 1.0 per cent lactic acid caused segmentation.

The addition of sodium oleate and hydrolyzed olive oil caused flocculation of the barium and segmentation in some subjects.

The diet partaken by the subject before examination may affect the pattern. In one subject a segmentation pattern was produced by a high-fat supper twelve hours before the examination. If a low-fat supper was taken, the pattern was normal.

In vitro, mucus containing gastric and duodenal secretions caused rapid and firm flocculation of barium suspensions.

The authors conclude that the segmentation pattern does not necessarily mean disease, since a pattern which is identical can be produced in normal subjects by hypertonic solutions and fatty acids. This effect may be

the result of the stimulation of mucous secretion by these substances.

Twenty-five roentgenograms: 3 photographs.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Roentgenologic Study of the Colon. Value of the Double Contrast Enema. Robert D. Moreton and Charles W. Yates. Texas State J. Med. **45:** 157–163, March 1949.

Patients receiving the double-contrast enema are prepared routinely. A limited barium enema is then given. The opaque column is observed fluoroscopically until it reaches a point just beyond the splenic flexure, when the enema is stopped. The patient is then rotated to the right, causing the barium to gravitate as far as the hepatic flexure. Following evacuation, air is insufflated and stereoscopic roentgenograms are exposed with the patient prone and supine, or in other advantageous positions.

The authors believe the ideal routine study of the colon should include a double-contrast enema study, either as a supplement to the plain barium enema examination or as the primary procedure.

Errors of technic which may occur during this examination include inadequate preparation, over-filling with barium or air, slow evacuation allowing the barium to dry on the mucosa of the bowel, and failure to obtain suitable roentgenograms.

The double-contrast study is well recognized as the most suitable method for demonstrating polyps of the colon. It will also occasionally demonstrate a polypoid carcinoma which is not evident in the routine barium enema study. Lesions which appear to be completely obstructing to the barium enema may be more completely demonstrated with insufflated air, which will pass through the canalized portion of the lesion. Other conditions in which the double-contrast study is valuable include: chronic ulcerative colitis, ileocecal tuberculosis, diverticulitis, lymphogranuloma venereum and endometriosis. It may be helpful in differentiating extrinsic from intrinsic lesions.

Eleven roentgenograms.

C. R. PERRYMAN, M.D.
Baton Rouge, Louisiana

Treatment of Acute Intussusception by an Enema of Roentgenologic Contrast Medium. Gustaf Lindberg and Olallo Morales. Am. J. Dis. Child. **77:** 303–309, March 1949.

The authors report, from the Norrköping Hospital (Sweden), 18 consecutive cases of ileocolic intussusception occurring in children under three years of age, all of which were reduced by barium enema.

After describing the typical clinical and roentgen findings, the authors state that early cases (of less than twelve hours) can be reduced by a slowly administered barium enema, without forceful attempts at reduction; ether anesthesia or narcosis and manual palpation may be required in persistent cases. Barium should pass into the terminal ileum before the intussusception is considered to be reduced. The authors insist that there is no danger in this procedure in early cases and if the enema is administered slowly.

Six roentgenograms. One table.

HARRISON SHAPIRO, M.D.
Mount Sinai Hospital of Cleveland

Double Gall Bladders. Report of Four Cases, One with Suppurative Cholangitis and Bacteremia. N. Frederick Hicken, Vernon L. Stevenson, Lowry M. Allen, and Charles R. Cornwall. Surgery **25:** 431–440, March 1949.

A true double gallbladder is a congenital anomaly in which there are two complete gallbladder walls and two separate non-communicating cavities, each drained by its own cystic duct. The paired cystic ducts may empty into the same or different segments of the extrahepatic biliary system, or the ducts may fuse in a Y-shaped pattern to form a common cystic duct, which then unites with one of the large biliary radicles. The condition is not to be confused with a bilobed or bifid gallbladder, in which there is merely a division of the cavity into two compartments by a longitudinal membranous septum.

The roentgen diagnosis may present difficulties: the two gallbladders may not be closely associated; when they are contiguous, they may have a common peritoneal investment giving them the appearance of a single structure. Occasionally two distinct gallbladder shadows or a double row of stones may be demonstrable roentgenographically. If, however, one of the gallbladders contained stones or became inflamed while the other remained normal, cholecystography would reveal the normal gallbladder shadow and the diagnosis would be missed. [It would seem likely that if one of a pair of gallbladders became diseased, the other would also be involved, and this hypothetical situation would almost never be found.]

Four cases are reported here, 2 of which were confirmed surgically. In the other 2 the paired gallbladders were normal except for some impairment of motor function and were demonstrable on the screen. In the operated cases the gallbladders were not visualized on the film. In 1, the accessory organ was not recognized until cholangiography was done, but in the other the two gallbladders were side by side and were removed together. Both gallbladders in each case contained stones; 1 case was complicated by a suppurative cholangitis and bacteremia.

Six roentgenograms; 1 photograph; 2 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE MUSCULOSKELETAL SYSTEM

Unfused Ossification Centers Associated with Pain in the Adult. Paul C. Swenson and Daniel Wilner. Am. J. Roentgenol. **61:** 341–353, March 1949.

The authors have found two centers of ossification which may remain unfused and be associated with pain. They are: (1) the tarsal scaphoid (navicular) and (2) the tibial tubercle.

The accessory scaphoid, or divided navicular, is situated at the insertion of the tendon of the tibialis posticus and generally closely connected with the tuberosity of the scaphoid by fibrocartilage or fibrous tissue, or it may be quite free and have no connection to the scaphoid. The theories as to the underlying pathologic process are discussed. They include: (1) traumatic synovitis of the posterior tibial tendon, (2) faulty mechanics of the foot, (3) traumatic arthritis, (4) bursitis, and (5) secondary inflammatory changes in the surrounding soft tissues. Pain is the outstanding symptom. In the differential diagnosis, one must consider fracture and osteochondritis (Köhler's disease). In the

former there is a history of injury, the finding is unilateral, and an isolated fracture of the scaphoid is quite rare. The latter condition usually does not appear before the twelfth year. Treatment consists in surgical removal of the unfused bone.

There are wide variations in the normal pattern of the tibial tubercle which are often considered pathologic. Excessive traction on the patellar ligament accounts for the pain because of the pre-existing weak bands between the tibial tubercle, tibial epiphysis, and the patellar ligament. Roentgenologically, Osgood-Schlatter disease is to be differentiated from a tibial tubercle by thickening of the patellar ligament at its insertion, presence of irregular bony spicules extending from the anterior surface of the tubercle into the ligament itself, and displacement of the fragments away from the shaft. Treatment consists of cross-strapping with adhesive or elastic bandage, with physiologic rest.

Thirty roentgenograms. SHOZO IBA, M.D.
Cleveland City Hospital

Prevalence and Distribution of Ossification Centers in the Newborn Infant. Amos Christie. Am. J. Dis. Child. **77:** 355–361, March 1949.

A study was made of the relative frequency of appearance of ten centers of ossification in 1,112 single, non-syphilitic newborn infants. This included approximately equal numbers of Negro and white children, males and females, all in good enough physical condition to allow roentgen examination within seventy-two hours following birth. Only the presence (not the size) of these centers was considered.

The ossification centers studied were: the right calcaneus, talus, distal epiphysis of the femur, proximal epiphysis of the tibia, cuboid, head of the humerus, capitate, hamate, third cuneiform, and head of the femur. They appeared in this order of frequency. The infants were divided into weight groups spanning the range between less than 2,000 gm. to more than 4,000 gm. Each such group contained male and female, white and Negro infants. The frequency of appearance of these centers is summarized in a table in which all of these factors are considered.

It was found that the females were more mature, with regard to the number of centers present, than the males, and that Negro infants were more mature than the white. It was also observed that the heavier the child, the greater the number of centers present.

These findings confirm previous clinical impressions that Negro infants are more mature at birth and that female infants of either race are more mature than males. The importance of accurate estimation of fetal size and maturity in many complications of pregnancy is pointed out and it is suggested that information concerning the relative osseous (and physiologic) maturity of the infant can be gained *in utero*. It is inferred that the order of appearance of epiphyses is the same as the frequency with which they were seen in this study.

One table. HARRISON SHAPIRO, M.D.
Mount Sinai Hospital of Cleveland

Hyperparathyroidism—Simulating Paget's Disease. Sidney P. Zimmerman. Ann. Int. Med. **30:** 675–681, March 1949.

The consensus among investigators interested in bone disease is that generalized osteitis fibrosa cystica (von Recklinghausen's disease), due to hyperparathyroidism, and osteitis deformans (Paget's disease) represent two independent clinical entities. Occasionally, however, a patient is seen exhibiting features of both hyperparathyroidism and Paget's disease. Such a case is reported.

R. J., a 39-year-old colored woman, was admitted to Goldwater Memorial Hospital (New York) in January 1944, because of progressive cardiac failure and invalidism resulting from an old left hemiplegia. Some four years earlier roentgen examination had revealed numerous osteofibrotic changes in the ribs, especially in the region of the costochondral junction, in the upper end of the right tibia, the pelvic bones, the long bones of the extremities, and the phalanges of the hands. The calvarium was markedly thickened, giving the cotton-wool appearance characteristic of Paget's disease. Hypercalcemia, hyperphosphatemia and increased serum phosphatase activity were found on two examinations. A rib biopsy yielded the histologic picture of healing osteitis fibrosa. An exploratory operation was performed (1940) and a greatly enlarged parathyroid gland was discovered and removed. Histologic section showed an encapsulated adenoma. One week following surgery, the calcium and phosphorus levels of the blood were found to be normal, but there remained an increase in the serum phosphatase which subsided only after a long interval.

Roentgenograms made following admission to the hospital in 1944 showed evidence of Paget changes in the skull, pelvis, femora, ribs, and fingers. The blood calcium, phosphorus, and alkaline phosphatase were normal.

Because of the relatively young age of the patient, the reversion to normal of the serum alkaline phosphatase, the unusual distribution of the lesions, especially in the ribs and fingers, and the proved diagnosis of hyperparathyroidism, it was felt that this case was to be classified as von Recklinghausen's disease which on healing acquired the bone picture of Paget's disease, rather than as hyperparathyroidism associated with Paget's disease.

Six roentgenograms; 1 table.
STEPHEN N. TAGER, M.D.
Urbana, Ill.

Osteitis Fibrosa Disseminata. D. J. MacRae. Brit. M. J. **1:** 389–392, March 5, 1949.

This is a case report of osteitis fibrosa in a 25-year-old white male with demonstrable lesions in the skull and right humerus. The clinical, roentgen and biochemical aspects of the syndrome are considered, and a discussion of the etiologic theories is given, but no new evidence is presented. The author seems to favor a relationship to icterus gravis neonatorum, first advanced by Braid (Arch. Dis. Childhood **7:** 313, 1932; **14:** 181, 1939). The suggestion is made that a check of the maternal Rh factor be made in these cases.

Two roentgenograms.
ALBERT R. BENNETT, M.D.
Mount Sinai Hospital of Cleveland

Compression Fractures of the Spine Complicated by Injury to the Spinal Cord. John R. Norcross. Surg. Clin. North America **29:** 189–194, February 1949.

Thorough x-ray and neurological examinations are necessary before any conclusions about the extent of spinal cord involvement in injuries to the spine can be

reached. Most spine fractures consist of simple wedging of a vertebral body, without cord symptoms. They are produced by forceful flexion and may be treated by immobilization in hyperextension. A certain group of comminuted fractures of the vertebral body, however, are also produced by forcible flexion. These cases demand careful roentgen study, as a fragment of the posterior portion of the body may extend into the neural canal, in which event hyperextension is contraindicated, as it may lead to displacement of the fragments, producing cord symptoms or increasing damage to the cord already present.

Fracture dislocations of a vertebra constitute perhaps 20 per cent of vertebral fractures. The important point to remember in these cases is that the intervertebral joint is dislocated, the fracture being of secondary concern. Forward displacement of a vertebral body on the one below produces one of two effects: fracture of the neural arch, including the articular processes, or complete dislocation of the interarticular joints. Oblique views show more clearly which of these conditions is present. The distinction is of importance for the institution of treatment. When the articular processes have been fractured, simple cautious hyperextension will usually correct the displacement. In the presence of interarticular dislocation, it is necessary to study the film to determine the relation of the articular processes to each other. In cases of "locking of the articular processes," open reduction is indicated.

The neurological findings in spinal injuries may result from a physiological block without actual destruction of nerve cells or from an actual disruption of nerve fibers. The early neurological findings are the same in both instances for the same level.

The present trend in all therapy is conservative. After reduction of the spinal fracture, the patient must be studied from the standpoint of possible spinal block. Laminectomy is indicated only when there is evidence of pressure on the cord.

JOE B. SCRUGGS, M.D.
University of Arkansas

Mechanism of the Structural Changes in Scoliosis: Preliminary Report. Alvin M. Arkin. New York State J. Med. **49:** 495–499, March 1, 1949.

The author shows how a functional scoliosis can progress into a fixed structural scoliosis, with wedging and deformity of the vertebra. Whatever the cause of the functional curve, as soon as it has produced a deviation exceeding a certain critical value, compression is concentrated on a small section of the growing epiphyseal plate sufficient to arrest the growth in height on the concave side and lead to wedged vertebral deformity characteristic of the apex of a scoliotic curve. Wedging can be explained only by unilateral epiphyseal arrest, since the same tremendous compression applied after growth is completed does not cause wedging. This wedging of the vertebra produces a change in the axis through which normal lateral bending occurs and thus produces the kyphoscoliosis seen clinically. In addition, the mechanism of rotation of the wedged vertebral bodies and the development of compensatory curves, with the relationship of the latter to treatment, are discussed. The author postulates that adolescent kyphosis ("vertebral epiphysitis") may be explained by a similar mechanism. Diagrams of the various factors producing structural changes in scoliosis supplement the text.

WILLIAM H. SMITH, M.D.
Louisville, Ky.

Results of Operations for Lumbar Protruded Intervertebral Disc. John Raaf and George Berglund. J. Neurosurg. **6:** 160–168, March 1949.

Two hundred and twenty-four patients were operated on for protruded intervertebral disks by one of the authors over a ten-year period. The clinical diagnosis proved to be correct in 81.25 per cent of the series. Myelography with pantopaque was done in 103 cases, with lipiodol in 27, and with thorotrast in 4.

Contrast Medium	Diagnosis Proved Correct	Myelogram Indicated Disk, but None Found	Myelogram Indicated No Disk, but Disk Was Found
Lipiodol (27 cases)	24 (88.9%)	3	0
Thorotrast (4 cases)	4 (100%)	0	0
Pantopaque (103 cases)	79 (76.7%)	21	3

In 12 cases in which surgery would not have been undertaken on the basis of the clinical signs, myelography was positive and a disk was found at operation.

Pantopaque studies were particularly useful in the demonstration of multiple disk protrusions, which may otherwise be missed, and in designating the exact site of protrusion, which cannot always be determined clinically. The authors believe an examination of this type is less harmful than exploration of extra disk spaces. "The more one limits surgery and the less one disturbs articular facets, the better the end-results."

Postoperative results and the economic aspects are also discussed.

Three charts; 5 tables.

HARRY J. PERLBERG, JR., M.D.
New York, N. Y.

Distentional Luxation, an Early Symptom Sometimes Occurring in Various Conditions of Pain in the Hip Joint. Jan-Carl Encrantz. Acta radiol. **31:** 257–263, March 31, 1949.

Distentional luxation as here employed indicates distention of the soft tissues within the joint. When the hip joint is involved, there is outward-downward displacement of the femoral head, with subsequent outward-upward displacement. The diagnosis of distentional luxation is made by measuring the distance between the articular cortices. A difference of 2 mm. or more between the sound side and the diseased side, on a perfectly centered film with the hips in a symmetrical position, is considered indicative of abnormal distention. This abnormality has been found, not infrequently, in cases of septic arthritis of the hip, osteomyelitis, and coxitis simplex. Temperature elevation or elevated sedimentation rate calls for serious consideration of the use of chemotherapy. If there is no clinical evidence of infection, the possible etiology may be over-exertion, infection of low virulence, or trauma.

Seven roentgenograms; 2 tables.

M. M. MANALAN, M.D.
Indiana University

Osteoarthritis of the Hip. Alex Robinson. Canad. M. A. J. **60:** 161–165, February 1949.

The author presents a general discussion of osteo-

arthritis of the hip, drawing largely upon the literature. This condition has been held to represent an "aging process" resulting from a combination of age, trauma, and senescence of tissue, but while these are predisposing and precipitating factors, they cannot be satisfactorily regarded as the chief etiologic agents. Local interference with the blood supply has been considered of primary importance by some. The pathologic process is one of cartilaginous degeneration resulting in hypertrophic proliferation with eventual ossification.

Osteoarthritis is to be considered in a middle-aged individual with a history of pain in the hip of insidious onset which is aggravated by activity and relieved with rest. This diagnosis is further supported by the typical roentgen findings, consisting of narrowing of the cartilage with diminution of the joint space in the weight-bearing axis. Exostoses are present in 95 per cent of the cases.

The patient can be reassured that he will not become a helpless invalid with multiple deformities such as may occur in rheumatoid arthritis. With simple methods of treatment, much benefit can be derived.

Two roentgenograms.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Degenerative Osteoarthritis of the Hip Joint: Survey of Degenerative Arthritis Secondary to Aseptic Necrosis of the Femoral Head. Thomas Horwitz. Arch. Surg. **58:** 251–272, March 1949.

A study of 81 patients with degenerative arthritis of the hip joint was made, with special attention to the pathology and pathogenesis of the disease. In 48 patients one or more causes for the condition were apparent, while in 33 the disease was apparently spontaneous. In either case the pathologic anatomy was the same. There were proliferation of bone at the junction of the femoral head and neck, denudation of the articular surface of the femoral head, and flattening and mushrooming of the head, producing a deformity similar to that of insufficiently treated Legg-Perthes disease and of slipped capital epiphysis. This deformity and the thickening of the femoral neck resulted from the deposition of periosteal bone. The roentgenographic findings were thinning of the joint space, subchondral sclerosis of the femoral head and acetabulum, and subchondral cyst-like radiolucent areas. Enlargement of the femoral head, which sometimes projected beyond the lateral margin of the acetabulum, led to compensatory shelf formation of the acetabular rim. True subluxation sometimes was present. While the mushroom type of deformity of the femoral head was common, cases secondary to protrusion of the acetabulum showed a relatively normal head deeply placed in the deformed socket.

Early and adequate treatment of lesions which may lead to deformity is emphasized as a prophylactic measure. If surgical treatment is needed, arthrodesis gives the best functional and symptomatic result.

Eight figures, including 17 roentgenograms.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Osteoid Osteoma: Report of a Case with Probable Double Lesion. Paul W. Lapidus and Edward P. Salem. Arch. Surg. **58:** 318–327, March 1949.

A 16-year-old white boy had two independent osteoid osteomas of the femur, one in mid-shaft and one in the lesser trochanter. The specimen of the first location was destroyed in fixing, so that no microscopic proof was available, but the gross appearance was termed typical by the pathologist at operation; the second lesion was typical both grossly and microscopically. The removal of the first lesion partly relieved the symptoms, and after removal of the second relief was complete. This is said to be the first reported case of a double lesion.

Six roentgenograms; 2 photographs.

LEWIS G. JACOBS, M.D.
Oakland, Calif.

Solitary Plasmocytoma of Bone. H. Holden. Brit. M. J. **1:** 437–438, March 12, 1949.

The author reports a solitary plasmocytoma involving the right first rib. When the patient, a 60-year-old female, was first seen, roentgen examination showed almost complete destruction of the rib. Biopsy led to a diagnosis of plasmocytoma. Radiation therapy was instituted, the mass disappeared, and in a follow-up period of two years no recurrence or other demonstrable lesion was observed.

Three roentgenograms; 1 photomicrograph.

ALTON S. HANSEN, M.D.
Peoria, Ill.

GYNECOLOGY AND OBSTETRICS

Changing Concepts of X-Ray Pelvimetry. A. E. Colcher and Walter Sussman. Am. J. Obst. & Gynec. **57:** 510–517, March 1949.

The authors present a concise description of the changing concepts in present-day x-ray pelvimetry. No universal language or technic is now employed wherein radiologists and obstetricians may use the same terms and make similar interpretations.

There are at least five popular x-ray measuring devices, each of which should give accurate results, so that accuracy is not a problem. In measuring diameters the coccyx may be eliminated as a criterion because it is a mobile unit and presents no real obstacle. The true conjugate diameter has no corresponding transverse diameter and is well above the brim of the true pelvis. It is not considered a critical factor in the progress of labor. In 1905, thirteen diameters were recognized, and now there are many more. The lateral view to determine the anteroposterior diameter has been definitely standardized. With the authors' technic the very same technical factors for measuring the pelvis in the lateral view and in anteroposterior positioning are not possible. When the head is the presenting part, its diameters can be measured with the same ruler, which has been placed in the proper plane. The suboccipito-bregmatic and biparietal diameters are believed to be of greater importance.

The number of methods of x-ray pelvimetry published emphasizes its justifiable use in obstetrics. The authors' series of 450 cases tends to show a decrease in the incidence of cesarean section in cephalopelvic disproportion and a decrease in fetal mortality. They add that x-ray pelvimetry is not more popular because of the multitude of technics, different diameters, and elements of evaluation. They therefore suggest formulation of standards for a universal technic and terminology which will be simple and concise enough to be

accurate in the hands of both the radiologist and obstetrician.

Five illustrations. ROBERT H. LEAMING, M.D.
Jefferson Medical College

Evaluation of Radiographic Pelvimetric Technics. Paul C. Swenson. M. Clin. North America **32:** 1659–1671, November 1948.

In discussing the role of pelvimetry in obstetrics, Swenson states that the ability to study the pelvic classification and fetal-pelvic relationships far transcends the importance of the pure measurements, and it is in this particular field that x-ray examination is of the most value. It is not so much a matter of saying that one case will have to be sectioned and that another will not, but rather to call attention to variations of shape and size which may give trouble and put the obstetrician on his guard.

For mensuration, the author employs the Colcher and Sussman pelvimeter. Film examination includes the following projections:

(1) Stereoscopic anteroposterior film of abdomen and pelvis.
(2) Erect lateral film for a study of pelvic architecture and fetopelvic relations at the inlet.
(3) Recumbent soft-tissue lateral film with special reference to the fetal skeleton and uterine soft parts.
(4) An occasional anteroposterior view of the sacrum and pubis angled 45 degrees toward the head for a study of form and size of the pubic arch and architecture of the sacrum. (An estimation of the pubic arch can be obtained from anteroposterior stereoscopy as well.)
(5) In breech presentation the ruler is placed at the midpoint of the fetal head by palpation before the recumbent lateral film is made.

All films are taken at a 35-inch skin-target distance with par-speed double intensifying screens, using the Potter-Bucky diaphragm. The following range of factors is used for film exposures: anteroposterior stereoscopy of abdomen and pelvis, 65 to 78 kv., $5^1/_2$, to $10^1/_2$, seconds, 50 ma.; erect lateral film, 70 to 80 kv., 7 to 14 seconds, 50 ma.; recumbent soft-tissue lateral film, 60 to 66 kv., 3 to 6 seconds, 50 ma.

During a two-year period, of 250 cases seen on the private service at the Jefferson Hospital, Philadelphia, 25 per cent showed some peculiarity in the shape or size of the pelvis, but most of these were borderline. In none did the measurements *per se* play a part in determining whether operative delivery should or should not be employed. The remaining 75 per cent of the cases showed no bony abnormality or disproportion.

Eight figures, including 14 roentgenograms.

Simplified Method of Fetal Roentgencephalometry. Results Checked in 482 Cases. Richard Torpin and J. L. Allgood, Jr. Am. J. Obst. & Gynec. **57:** 455–460, March 1949.

An additional method of roentgen cephalometry is introduced by the authors, who at the same time give a concise review of the various modern methods employed in this examination.

Briefly, the fetal head is essentially cylindrical. One end of the cylinder is the face and the opposite end is the occiput, with the greatest circumference embracing the biparietal and suboccipitobregmatic diameters. A review of a large number of heads maasured shortly after birth at term demonstrated that these diameters tend to range from 8.0 to 10.5 cm.

The new procedure is an isometric method with a single addition to the commonly employed lateral soft-tissue technic reported by Snow and Powell. This addition consists of a 10-cm. lead scale strapped to the mother's abdomen over the fetal head. It is necessary that this scale lie in a longitudinal plane on an elevation as near the center of the head as possible. The scale image may be used to measure, by calipers, the diameter of the head in the plane of the biparietal or suboccipitobregmatic diameter, whichever is obtainable at the time.

The predictable error of the method, if the technic is as exact as possible, in the hands of a trained technician, is not greater than 5 per cent plus or minus, that is, 0.5 cm. These results were checked in 482 cases.

Two illustrations; 1 chart.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Influence of the Uterus on the Ureter During Pregnancy. W. Rabinowitsch. Urol. & Cutan. Rev. **53:** 81–83, February 1949.

Dilatation of the right renal pelvis and ureter during pregnancy has been reported by many observers. Some attribute it to mechanical pressure, while others believe it to be due to hormonal influences (corpus luteum).

The author reports observations which he believes confirm the pressure theory. Roentgenograms of a 20-year-old patient in the sixth month of pregnancy indicated that right-sided pressure of the uterus on the ureter caused a 90° declination kink of the ureter with consequent retention of urine in the renal pelvis, hydronephrosis, and hydroureter, with pain resembling that of nephrolithiasis. When the patient lay on the left side, the kink was reduced and the pain ceased. One year later the ureter appeared normal, though a slight degree of hydronephrosis persisted.

Three roentgenograms.

MAURICE D. SACHS, M.D.
Cleveland, Ohio

Clinical and Roentgen Manifestations of Erythroblastosis Fetalis. Max Ritvo, Irving A. Shauffer, and Gerald Krosnick. Am. J. Roentgenol. **61:** 291–301, March 1949.

In erythroblastosis fetalis there are generalized edema, jaundice, anemia and erythroblastemia. Intrauterine death and maceration of the fetus may occur, with enlargement of the liver and spleen, extramedullary erythropoiesis, and changes in the bones. The condition is usually seen in children born of mothers who are Rh negative and fathers who are Rh positive.

Titer estimations in the maternal blood indicate the impending development of hemolytic disease of the infant and may serve as an index of the severity of the condition. Determination of injury to the fetus is best made in the last weeks of the pregnancy.

Studies carried out at the Boston City Hospital indicate that roentgen studies of the fetus *in utero* afford valuable data and may permit of a diagnosis of erythroblastosis fetalis in certain instances. The roentgen

findings comprise (1) soft-tissue changes consisting of generalized edema and enlargement of the liver and spleen; (2) abnormalities of the skeleton, with increased densities in the bones; (3) evidences of fetal death.

Four case reports are presented.

Fifteen roentgenograms. SHOZO IBA, M.D.
Cleveland City Hospital

Uniumbilical-Dibrachi-Dicephalic Monster: Roentgenographic Diagnosis in Utero, Delivery by Low Classical Cesarean Section. Joseph V. D'Agostino, Cyril M. Levin, and Harold R. Wainerdi. Am. J. Obst. & Gynec. **57:** 599–602, March 1949.

The diagnosis of a full-term monster of the uniumbilical dibrachi-dicephalic type, while yet *in utero*, was made by roentgen examination, and a low classical cesarean section was performed. The monster lived about an hour. Autopsy revealed two well shaped heads and necks on a single pair of shoulders. The duplication of the spine continued down to the sacrum. Clavicles were absent, and there was a single pelvis. Internally, equal duplication ceased at the level of the stomachs. There was a single liver, but duplication of the heart, lungs, gallbladder, pancreas, stomach, and small bowel down to the cecum.

The mother's convalescence was uneventful and the psychic trauma was practically nil. This presentation demonstrates the efficiency of roentgen examination where a decision is to be made as to elective cesarean section.

One roentgenogram; 1 photograph.
ROBERT H. LEAMING, M.D.
Jefferson Medical College

Roentgen Diagnosis of Adenomyosis Uteri. Morris A. Goldberger, Richard H. Marshak, and Mortimer Hermel. Am. J. Obst. & Gynec. **57:** 563–568, March 1949.

Adenomyosis of the uterus is characterized by benign invasion of the endometrium into the uterine musculature. This invasion of endometrium into muscle forms tube-like structures into which radiopaque media such as skiodan acacia may penetrate. The authors have noted that the opaque medium enters the endometrial channels and ends in tiny sacs, especially on the superior surface of the uterus.

In those cases which do not reveal the tiny sacs either because of clotted blood within the endometrial channels or muscle overgrowth with a pinchcock effect, there is an irregularity of the uterine border which is more marked than that noted in uterine hyperplasia.

Hysterography with the use of skiodan acacia is advocated in the preoperative diagnosis of adenomyosis uteri. The authors observed no reactions or ill effects following this procedure.

Nine roentgenograms.
ROBERT H. LEAMING, M.D.
Jefferson Medical College

THE GENITO-URINARY SYSTEM

Hyperchloremic Acidosis and Nephrocalcinosis. The Syndrome of Pure "Lower Nephron" Insufficiency. Ezra M. Greenspan. Arch. Int. Med. **83:** 271–291, March 1949.

Special significance has been attributed to the localization of the renal calcifications in those cases of idiopathic nephrocalcinosis associated with a unique form of chronic renal failure characterized by severe, intractable chronic hyperchloremic acidosis of months or years duration together with pronounced chronic polyuria, polydypsia, asthenia, and either osteoporosis (adults) or "renal rickets" (children). Roentgenologically, the calcifications usually are visible as numerous clumps of symmetric bilateral submiliary, stippled, cauliflower-like calcium deposits confined to the renal pyramids. These calcifications outline the caliceal systems of both kidneys perfectly, despite the absence of calculi in the calices or pelves. Differentiation from other types of renal calcification, including those due to hyperthyroidism, is based on different biochemical abnormalities. Those peculiar to this entity consist of an unusual form of chronic discrete lower nephron insufficiency manifested by isosthenuria, diminished ammonia excretion, and a fixed urinary alkalosis in the presence of a blood acidosis, hyperchloremia, and relatively good glomerular function.

Following a review of the literature, the first case in an adult male to appear in the literature is presented. The patient was successfully treated for almost three years on a sodium citrate and citric acid regimen; the rationale for this treatment is discussed. The differential diagnosis, physiologic mechanism of lower nephron insufficiency, and evidence in favor of drug toxicity as an etiological factor are presented.

Four roentgenograms; 1 chart; 4 tables.
HARRY J. PERLBERG, JR., M.D.
New York, N. Y.

Radioscopy in Nephrolithotomy. N. J. Nicholson. Brit. J. Urol. **21:** 24–26, March 1949.

A method for safely utilizing fluoroscopy in cases of nephrolithotomy has been devised. It provides adequate protection from scattered radiation and allows the surgeon to see the fluoroscopic image without lowering his head into the wound. It eliminates the technical awkwardness, possible distortion and delay incident to the use of films. All parts introduced into the operative field are capable of being sterilized.

Although a special apparatus has been developed, any mobile x-ray unit will suffice if the tube head can be fitted with a special cone and applicator constructed of sterilizable material. The applicator extends to and confines radiation to the exposed kidney.

The screening apparatus consists of a hinged frame which holds an oval fluorescent screen. A basal pillar connects the frame to a highly polished mirror mounted on a ball-joint to facilitate angulation in any direction. The kidney is bound to the screen by rubber bands and the cone is applied to the opposite side of the organ.

The screen is completely sealed in perspex (polymerized methyl methacrylate). It is sterilized by immersing in 40 per cent aqueous formaldehyde for seventy-two hours. The remaining pieces may be boiled or autoclaved. Dosimeter readings revealed negligible dangerous radiation during screening.

Five photographs. HARRY J. PERLBERG, JR., M.D.
New York, N. Y.

The Fetal Renal Secretion and Its Significance in Congenital Deformities of the Ureters and Urethra. Sven Roland Kjellberg and Ulf Rudhe. Acta radiol. **31:** 243–249, March 31, 1949.

The authors feel that the mechanical explanation for

dilatation of the urinary passages of the newborn in the presence of congenital posterior urethral valves is valid. This concept is not generally accepted, as it presupposes fetal renal secretion. This latter phenomenon has been established by others by noting the presence of urine in fetal bladders and by chemical examination of amniotic fluid. The authors obtained further evidence of it by the contrast visualization of the urinary collecting system after the injection of a 35 per cent iodine solution into the umbilical vein. Their experiments were performed on human embryos of four to five months during cesarean sections (in cases of legal abortion), before placental separation, and on rabbits. The subsequent radiographic studies show clearly that dye has been secreted by the fetal kidneys.

Four roentgenograms. J. SCOTT, M.D.
Indiana University

Clinical Significance of the Hypertonic Kidney Pelvis in Non-Specific Pyelitis. Paolo Biondetti. Radiol. med. (Milan) **35:** 191–230, March 1949. (In Italian)

This is a study of 138 cases of non-specific pyelitis. The radiological appearance of the pelvis was normal in 14 per cent, hypotonic in 40 per cent, and hypertonic in 45 per cent. The author states that a narrow hypertonic pelvis is usually found in cases of slight infection, and a hypotonic pelvis where the infection has been severe or has persisted for a longer time. There are, however, so many individual variations of shape and size of the normal kidney pelvis that it may be difficult for the radiologist to distinguish between a normally narrow pelvis and a spastic inflamed pelvis.

Nineteen figures. including roentgenograms.
CESARE GIANTURCO, M.D.
Urbana, Ill.

APPARATUS AND TECHNIC

The Semiautomatic Rapid Film Changer: Its Use in Radiography and the Recording of Rapid Physiological Movements. Charles E. Duisenberg. California Med. **70:**182–188, March 1949.

The author describes an automatic cassette changer developed at Stanford University Hospital. Films measuring 11 × 14 inches are used and exposures are made at a rate of one to two per second for a total of 20 films, that is, if the tube has that high a capacity. The cassette changer has been used for a number of different types of examination, with successful recording of phases of physiological motion and the progress of opaque material, as in phlebography, aortography, and cerebral arteriography, in the demonstration of esophageal peristalsis and the mucosal pattern of the stomach, and to record ureteral peristalsis.

Seven groups of serial roentgenograms.
MAURICE D. SACHS, M.D.
Cleveland, Ohio

Hyaluronidases as a Factor Hastening the Spread and Absorption of Water-Soluble Radio-opaque Substances Deposited Intracutaneously, Subcutaneously, or Intramuscularly. Olle Olsson and Olov Löfgren. Acta radiol. **31:** 250–256, March 31, 1949.

This paper is concerned with the feasibility of introducing contrast media subcutaneously, intracutaneously, or intramuscularly for urographic studies and augmenting its absorption by hyaluronidase. This procedure is recommended when venepuncture is impractical or difficult, *e.g.*, in infants.

After preliminary tests on animals, intracutaneous, subcutaneous, and intramuscular injections of diodrast and hyaluronidase were given to human subjects. At the same time, at a different anatomical site, diodrast and normal saline were similarly introduced for comparison studies. It was noted that there was rapid spread and absorption of the contrast medium at the site prepared with hyaluronidase, while radiopacity persisted at the site of the control injection, as shown by subsequent radiograms. Swelling and tenderness were less marked or absent altogether when hyaluronidase was deposited. The results were less dramatic with intramuscular and subcutaneous injections than when the intracutaneous route was used.

In attempted urography, 2.5 TRU (turbidity reducing units) hyaluronidase was injected subcutaneously and intramuscularly ten minutes prior to the introduction of contrast medium. No tenderness was noted subjectively and swelling was slight and subsided readily. Spread and absorption of the contrast medium were enhanced. There was only slight delay in absorption, as compared with intravenous injection, and optimal renal visualization was obtained in thirty minutes; the urograms were comparable to those following intravenous injection of contrast substances and satisfactory in both adults and infants.

The use of the enzyme, hyaluronidase, in promoting the spread and absorption of water-soluble contrast media in roentgenological soft-tissue studies and lymphography is also mentioned.

In the United States, Simon and Narins have reported a study on the effect of hyaluronidase on the absorption of a radiopaque substance deposited subcutaneously in guinea-pigs (Am. J. Roentgenol. **61:** 91, 1949).

Five roentgenograms. J. WILSON, M.D.
Indiana University

X-Ray Diagnostic File System. John P. Wood. U.S. Nav. M. Bull. **49:** 339–346, March-April 1949.

This is a brief review of systems for filing x-ray films, an application to naval conditions of one particular system, namely, that of Sussman (Am. J. Roentgenol. **46:** 109–118, July 1941). A children's anatomical file for comparison and reference is also described.

S. F. THOMAS, M.D.
Palo Alto, Calif.

RADIOTHERAPY

Roentgen Treatment of Cutaneous Carcinoma Involving Cartilage. Leo M. Levi. Am. J. Roentgenol. **61:** 380–386, March 1949.

Many physicians, including some radiologists, have the opinion that cutaneous cancer which involves cartilage should not be treated by radiotherapy because of the danger of the development of perichondritis. The author believes, as do others whom he quotes, that "the presence of cartilage in uncomplicated cases does not contraindicate the use of properly selected radiation therapy."

In this paper there are reports on 6 typical cases of cutaneous cancer involving the cartilage of the ear or nose. Four of these patients received low-voltage therapy (105 kv.), with aluminum filtration of 1.0 to 4.0 mm., for a total of 4,500 r (in air), given in three doses over a period of five to six days. The other two patients were treated with high voltage (200 kv.) and 1.0 mm. copper filtration, receiving 200 r in air per treatment for a total of 5,000 r in five weeks. None of the patients developed perichondritis. The follow-up period was two to seven years, all but one patient being followed five years or more.

Fourteen photographs. RICHARD A. ELMER, M.D.
Cleveland City Hospital

Castration as a Therapeutic Measure in Cancer of the Male Breast. Norman Treves. Cancer **2:** 191–221, March 1949.

In a series of 13 cases of carcinoma of the male breast, bilateral orchiectomy was found to have definite favorable effects on the primary lesion; in varying degrees it promoted healing in remote metastases, notably bone, and it may have influenced to a lesser degree the rate of growth in soft-part secondary deposits, especially the homolateral axillary nodes and pulmonary lesions.

Since hypertrophy of the adrenals has been shown experimentally to follow orchiectomy and since, at least in some conditions, the hypertrophied adrenal cortex secretes sex hormone, it was believed that irradiation of the pituitary might be indicated to decrease the adrenotropic function of the adenohypophysis. In the 3 cases in which this procedure was employed, no effect upon the activity of the cancer was observed.

Twelve roentgenograms; 18 photographs; 5 tables.

Certain Aspects of the Uterine Cervix Cancer Problem in Colorado. C. B. Ingraham, E. Stewart Taylor, and Eleanor Sinton. Rocky Mountain M. J. **46:** 214–218, March 1949.

Among 84 patients with carcinoma of the cervix seen at the Bonfils Tumor Clinic of the University of Colorado Medical Center, the five-year survival rate was 15 per cent. In this paper the authors discuss some of the problems in their locality which tend to cause this low survival rate. These factors are listed as follows: (1) the advanced stage of the disease when seen initially; (2) a high proportion of Spanish-American patients, the most underprivileged group in this region; (3) indigency, poor education, inaccessibility of medical aid, and lack of patient initiative; (4) poor medical, surgical, and social management; (5) the disadvantages of not being able to treat the cases referred completely.

Three tables. DONALD S. CHILDS, JR., M.D.
The Mayo Foundation

Carcinoma of the Cervix Uteri: A Study of 328 Cases. John W. Karr, A. L. Grohowski, G. J. Baron, T. B. Steinhausen, and S. R. Snow, Jr. New York State J. Med. **49:** 500–503, March 1, 1949.

The authors present a series of 328 proved cases of carcinoma of the cervix seen between 1926 and 1942 at Strong Memorial and Rochester Municipal Hospitals (Rochester, N. Y.). All cases were treated by radiation therapy and the methods employed separated themselves into three fairly well defined periods: 1926 through 1932, 1933 through 1937, and 1938 through 1942. The first of these was characterized by the use of large amounts of radium for relatively short periods, with repeated applications. Roentgen radiation was given by the massive dose method at widely separated and irregular times. In the second period there were wide variations in the dosage of radium and roentgen radiation. The third period was characterized by the use of smaller amounts of radium with better distribution and greater protraction of application. The total dose was less, most of the patients receiving between 4,500 and 5,500 mg. hr. Roentgen radiation was also given in smaller doses per treatment and over a greater length of time. Most of the patients received 200 r to two fields per treatment and over 80 per cent received more than 7,000 r (air) total.

Roentgen radiation was given before radium in 75 per cent of the cases in the third period, in 59 per cent in the second, and in only 10 per cent in the first period.

The five-year survival rates by periods were 13 per cent for the first, 25.9 per cent for the second, and 37.5 per cent for the third with an over-all survival rate of 26.2 per cent. Numerous tables showing survival according to grade of the tumor, age at onset of disease, presenting symptoms, etc., are included.

WILLIAM H. SMITH, M.D.
Louisville, Ky.

Radium Therapy of Carcinoma of the Uterine Body. Herbert Deuel. Radiol. clin. **18:** 31–37, January 1949. (In German)

Illustrations of 7 cases of carcinoma of the body of the uterus, from the Universitäts-Frauenspital, Basel, show the hysterographic appearances of these neoplasms and the placement of the radium containers for their treatment.

Twenty-eight roentgenograms; 2 photographs.
HANS A. JARRE, M.D.
Detroit, Mich.

Treatment of Advanced Carcinoma of the Ovary. B. Z. Cashman and E. V. Helsel. Am. J. Obst. & Gynec. **57:** 492–500, March 1949.

Carcinoma of the ovary is classified clinically in the following groups: (1) completely removable and apparently confined to the ovary alone; (2) completely removable but with adhesions or further involvement of other structures that can be removed; (3) only partly removable; (4) irremovable due to extension.

The authors believe that operation is indicated (*a*) to establish definitely the diagnosis and extent of disease; (*b*) in Groups 2 and 3 with the probability of removing all of the tumor; (*c*) in Group 3, which otherwise is 100 per cent fatal, to attempt salvage of life, since x-ray therapy in this group has not been curative.

The authors carefully review 12 cases, and discuss the treatment particularly of Group 3. If ascites is present, it may be eliminated or the intervals between tapping may be prolonged by resection of the involved omentum.

In Groups 1 and 2, total hysterectomy and removal of both adnexa should be done whether the disease is unilateral or bilateral. In Group 3, where the tumor is not completely removable, the procedure is modified accordingly and supravaginal rather than total hysterectomy is usually done. It is in the papillocystadenocarcinoma group that operation followed by x-ray therapy seems to increase the duration of life and the comfort of the patient. In cases with postoperative regrowth of the tumor, relief of pain followed repetition of x-ray therapy.

The authors are more optimistic about salvage of life in Group 3 cases when the disease has spread beyond the ovary.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Carcinoma of the Prostate: A Statistical Study and Evaluation of Endocrine Therapy, with a Preliminary Report of an Additional Method of Treatment. Harry Q. Gahagan, and J. L. Fischman. J. Urol. **61:** 587–590, March 1949.

An analysis is presented of 224 cases of carcinoma of the prostate seen at the Charity Hospital of Louisiana, in which some type of endocrine therapy was given 118 cases were treated by orchiectomy, and of these, 100 were adequately followed for at least one year or until death; 106 cases received stilbestrol therapy, of which 72 were adequately studied.

Results of therapy are based on time of survival from date of diagnosis, and the cases receiving endocrine therapy are compared with the large series of Nesbit and Plumb (Surgery **20:** 263, 1946), treated by other methods with an average survival of 21.2 months from diagnosis until death. In the authors' series the longevity was significantly prolonged compared to this control group, the group treated by orchiectomy showing a better average survival period (30.3 months) than that in which stilbestrol was used (20.5 months). Since half the patients in this endocrine series are still living, the total average months survival will, of course, increase with time.

The writers also mention 10 cases treated with deep x-ray therapy directed to the adrenals, in addition to the endocrine therapy, in the hope of decreasing the androgenic function assumed by the adrenals. All of these cases were far advanced, and in 3 there was marked improvement following therapy. The authors hope that adrenal irradiation may offer an additional therapeutic method, yet to be evaluated.

One graph.

DOUGLAS NAGLE, M.D.
University of Pennsylvania

Hodgkin's Disease: A Histopathological and Clinical Classification with Radiotherapeutic Response. Philip F. Sahyoun and Stuart J. Eisenberg. Am. J. Roentgenol. **61:** 369–379, March 1949.

A classification of Hodgkin's disease based on histopathologic criteria is presented. A correlation between the cellular components and their arrangement and the clinical course is established, so that longevity and response to roentgen irradiation can be predicted with a better degree of accuracy than heretofore.

Previous classifications of Hodgkin's disease were reviewed, and in general these were found to be in accord with the authors' views as to the fundamental changes in this disease. The authors differ, however, with the concept of Murray and Broders (Am. J. Clin. Path. **13:** 450, 1943) that the histopathologic grade of malignancy in Hodgkin's disease bears no relationship to life expectancy, and that the survival rate is the same for all grades.

Three types of Hodgkin's disease, exclusive of Hodgkin's sarcoma, are recognized on the basis of histopathologic criteria.

I. Compactly cellular type (slowly progressing): Characterized by compact structure of the tumor with only slight fibrosis. Range of maximum life expectancy forty-eight to one-hundred and sixty months.

II. Fibrogranulomatous type (moderately progressing): Characterized by granulomatous pleomorphism plus a tendency to fibrosis and necrosis. Range of maximum life expectancy twenty to sixty months.

III. Loosely cellular type (rapidly progressing): Characterized by a loose edematous structure, immature type of Sternberg-Reed cells, and numerous mitoses. Range of maximum life expectancy twelve to twenty months.

Microsections were examined by a microscopist who had no previous access to the case records or slides. Based solely on histopathologic criteria, the examiner made a diagnosis and stated his impression as to clinical course and life expectancy. These impressions were recorded and checked against the known clinical facts and the actual course of the patient.

Case histories are presented showing the response to roentgen therapy and the correlation between the course predicted by histopathologic criteria and the actual course. Nineteen of the 24 cases studied were followed adequately, and 17 followed the course predicted from a study of the histopathologic criteria.

Three photomicrographs.

JACK WIDRICH, M.D.
Cleveland City Hospital

Roentgentherapy of Benign Giant-Cell Tumor of Bone. Franz Buschke and Simeon T. Cantril. Cancer **2:** 293–315, March 1949.

Solitary benign giant-cell tumor of bone represents a definite entity characterized by certain clinical and radiographic findings and histologic features, a typical response to irradiation, and a good prognosis following adequate therapy. Neither the radiographic nor histologic features alone are pathognomonic enough to establish a diagnosis with certainty. It is essential that good roentgenograms and adequate biopsy material be examined by experienced observers. The most important single feature of the radiographic diagnosis is the location of the tumor in the bone: either in the anterior portion of the mandible or the epiphyseal portion of a long bone. Lesions in which osteolytic features are prevalent and atypically located lesions make certain diagnosis difficult.

The authors prefer a single course of roentgen therapy with a tumor dose of 4,000 r in from four to six weeks rather than repeated courses of smaller doses given at intervals of several months. Roentgen therapy in adequate dosage has given uniformly excellent results with regard to tumor control, bone regeneration, and

function. The conclusion has been reached that the probability of a malignant course following adequate roentgen therapy is so small that it should not influence indications for radiation therapy.

Ten case reports are given (including 1 of osteitis fibrosa cystica), with discussion of the salient features of each case.

Fifty-two roentgenograms; 8 photographs; 1 table.

DONALD S. CHILDS, JR., M.D.
The Mayo Foundation

Treatment of Plantar Warts by Single Dose Method of Roentgen Ray. J. Lewis Pipkin, C. Ferd Lehmann, and Arthur Ressmann. South. M. J. **42:** 193–200, March 1949.

The authors discuss the recent advances in the roentgen treatment of plantar warts and review the essential points of the single massive dose method. They stress the importance of meticulous attention to details of technic, including shaving of the overlying hyperkeratotic epidermis, which confirms the diagnosis, permits penetration of the radiation to the keratotic portions of the wart, and shows its true size.

The series reported here comprised 1,744 plantar warts in 1,000 patients. All were treated with a single dose of superficial radiation, with the following factors: 100 kv., 5 ma., no filter, half-value layer 0.9 mm. Al, skin-target distance 20 cm.; mechanical rectification.

The size of the warts ranged from 2 mm. to 12.5 mm. The importance of aftercare, with removal of the devitalized wart is stressed. No patient should be retreated, regardless of the amount or type of initial irradiation.

The success of this technic is borne out by the end results, which showed an over-all cure of 91 per cent.

Three tables.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Radiation Therapy of Ringworm of the Scalp. M. E. Mottram and Harold A. Hill. California Med. **70:** 189–193, March 1949.

The authors have treated ringworm of the scalp with a modification of the four-point technic, using a right lateral field with lead protection for the face, a left lateral field, and occipital and frontal fields. The treatment factors are 140 kv.p., 25 ma., 40 cm. focal skin distance, half-value layer 4 mm. Al or 0.2 mm. Cu. Each field receives 300 r in air, and only one field is treated per day. The course of therapy is completed within a week. Between the eighteenth and twenty-sixth day following completion of the x-ray series, epilation takes place and regrowth occurs in from two to four months. Ringworm is cured if the epilation is complete.

In a series of 125 cases treated, cures were obtained in all. About 40 per cent of these patients had some residual hair, which was removed by their own physicians. Two patients had a faint erythema following therapy; several patients had a vague "unwell" feeling, but only 3 actually reported nausea or vomiting during x-ray therapy. In the majority of cases there was no change in the color or texture of the hair, but in 5 instances the new hair was thought to be darker and in 3 instances the hair was thought to be lighter. In 3 others, the new growth of hair was curly.

The authors reserve irradiation for cases refractory to topical applications. The method is not employed in children approaching puberty. Other contraindications are: a severe dermatitis due either to infection or chemotherapy, an erythema due to ultraviolet radiation, and previous successful or unsuccessful roentgen epilation.

Six drawings illustrating the technic.

MAURICE D. SACHS, M.D.
Cleveland, Ohio

Irradiation of the Nasopharynx. A. N. Champion. Texas State J. Med. **45:** 153–156, March 1949.

Recurrent infections of the respiratory tract most frequently occur in the pharynx. The abundant lymphoid tissue in this area is susceptible to acute and chronic infections. Recognition of this fact has led to surgical removal of the tonsils and adenoids. Although the main mass of adenoids may be removed, islands of lymphoid tissue are often left behind. If infected, this tissue becomes hyperplastic. Apparently it is not the size of the lymphoid nodules that is important, but rather their location, coupled with the degree and kind of infection. The resultant hyperplasia, edema, and excessive mucus may readily cause eustachian tube blockage, or hemorrhage and infection of the mucosa of the middle ear. This may lead to conduction deafness, acute infection of the middle ear and mastoid, or the infection may spread forward to the nose and sinuses or downward to the trachea and bronchi.

Treatment of this condition should be started before irreversible scarring of the eustachian tube and middle ear takes place. Radium applicators offer a simple and safe method of attack. The author inserts 50 mg. into the nasopharynx, leaving the applicator in position for twelve minutes. One or two months later the application may be repeated if examination reveals insufficient shrinkage of the lymphoid tissue or lack of clinical improvement.

This procedure cannot be expected to remove a large mass of adenoids. If a chronic otitis media or an allergy is present, concurrent treatment of these conditions should be instituted.

The results obtained by irradiation therapy are variable. Shrinkage of the lymphoid tissue can be observed in nearly all cases. A few patients do not respond, probably because of insufficient irradiation or the formation of scar tissue. Both of these difficulties can be obviated by earlier and more irradiation.

Best results are obtained in cases of deafness due to eustachian salpingitis of recent origin. Recurrent aerotitis may be similarly treated. Patients with tinnitus or dizziness, relieved by inflation of the eustachian tube, may receive permanent relief from irradiation. Many patients with recurrent attacks of acute otitis media or chronic otitis media are helped. Others will volunteer the information that a previously noted postnasal discharge has decreased following nasopharyngeal irradiation.

Four audiograms.

C. R. PERRYMAN, M.D.
Baton Rouge, Louisiana

Treatment of Ankylosing Spondylitis and Osteoarthritis. F. Duval. M. J. Australia **1:** 301–303, March 5, 1949.

The striking feature of irradiation therapy in ankylosing spondylitis is the relief of pain and, to a lesser extent, of stiffness. Symptomatic and clinical improvement can be obtained in almost 80 per cent of cases. The author treats the spine and sacroiliac joints through

narrow ports, using 200 kv. with a filter of 1 mm. Cu and 1 mm. Al. Doses of from 200 to 400 r are given daily until a skin dose of 2,000 r has been delivered.

In osteoarthritis the duration of relief of pain is variable. In most cases there is a marked improvement for a period of from six months to two years. In about 10 per cent of cases there is an initial excellent response but within a month or six weeks there is a return of pain, and further treatment is ineffective. Best results are obtained in the spine. The knee joint appears to respond least well. X-rays generated at 200 kv. are used, and from 600 to 1,200 r are given over a two-week period.

In acute subacromial bursitis the author uses a dose of 150 to 200 r, through a 10 × 10-cm. field. In the majority of cases the pain will subside in forty-eight hours. A total dose of more than 800 r is rarely required. In more chronic cases one anterior and one posterior shoulder field are used, treated alternately with 300 to 400 r every two days for two weeks, so that each field receives from 900 to 1,200 r. The results in the chronic form are good in about half the cases, with relief of pain and rapid absorption of the calcareous deposits.

DONALD S. CHILDS, JR., M.D.
The Mayo Foundation

Roentgentherapy of Pain. Origène Dufresne. Canad. M. A. J. **60:** 227–229, March 1949.

Irradiation in many instances is most effective in relieving pain either by a direct or indirect action on the nervous elements. In principle, x-rays are indicated in most types of pain arising from known causes, such as inflammatory lesions, tumors, and vasomotor disturbances, and from unknown causes as in essential neuralgias. In the latter instance irradiation of the nerve roots or plexuses often is successful after repeated failure of local irradiation.

The author states that roentgen therapy should be used much more often for the relief of suffering patients and it is desirable that radiologists and physicians cooperate in the treatment of refractory pain by this method.

ROBERT H. LEAMING, M.D.
Jefferson Medical College

Clinical Radiation Dosage. Lionel Cohen. Brit. J. Radiol. **22:** 160–163, March 1949.

The response of animal tissues, both malignant and normal, to a given dose of radiation is remarkably constant if three factors are kept constant: (1) the quality of radiation or the specific ion density of the associated corpuscular emission, (2) the over-all time of irradiation, (3) the size of the field. The international r is adequate as a measure for roentgen and gamma radiations, but is not applicable to other types. It is proposed that a new unit, the "roentgen-equivalent-clinical," abbreviated as *rec* be designated, such that *rec* equals dose multiplied by the relative biological efficiency of the radiation. The latter factor then breaks into the reciprocals of the specific ion density, the over-all time, and the field size. The *rec* may be defined specifically as the clinical effect of 1 r of gamma radiation delivered through a 10-cm. field in twenty-four hours. Since 1,000 r of gamma rays delivered to a 10-cm. field at one sitting produces a threshold erythema, one kilorec is required for a threshold erythema.

The mathematical expression of the specific ion density follows from the fact that the biological efficiency of radiation increases with specific onization, which in turn increases wth diminishing voltage. This dependence is not continuous, but for practical purposes is the same from 20 to 100 kv., lower and slowly decreasing from 200 to 1,000 kv., and practically constant above 1,000 kv. From the relative number of r required to produce a threshold erythema, the specific ion density factor may be derived as follows: for 1,000 kv. and over, gamma rays, and betatron, the factor is 1.0; for conventional deep therapy 0.7; for superficial therapy at 140 kv. 0.5 and at 100 kv. 0.3; for neutrons and protons 0.2.

The time factors may be derived from the application of Schwarzschild's law and clinical observation as T^n where T is time and n is a figure representing the recovery component, which is 0.30 for skin and 0.22 for squamous-cell cancer.

The field-size factor is derived from empirical observations and the law that the dose required to produce a given skin reaction varies inversely with the area treated. Actually, on the basis of the definition of the *rec*, which gives the field as 10 cm. in diameter, the field-size factor may be expressed as follows:

$$\left(\frac{10}{\text{diam.}}\right)^{0.33} \text{ or } \left(2.5\,\frac{\text{perimeter}}{\text{area}}\right)^{0.33}$$

When the lethal dose in terms of erythemas is known, the required number of r of any type of radiation may be calculated. Three examples are given of such calculation.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

RADIOISOTOPES

Radioactive Iodine: Its Use in Studying Certain Functions of Normal and Neoplastic Thyroid Tissues. Rulon W. Rawson, Bengt N. Skanse, L. D. Marinelli, and Rex G. Fluharty. Cancer **2:** 279–292, March 1949.

The authors report studies on 23 benign tumors and 21 cancers of the thyroid, comparing the radioactive iodine concentrating capacity of tumor tissue with that of the surrounding normal tissue and attempting to correlate the iodine-concentrating function of these tumors with their histological patterns. The benign tumors, in general, were found to concentrate radioactive iodine, but this concentration was usually less than that possessed by the normal thyroid tissue. The more differentiated the histologic appearance of the benign tumor, the greater was the capacity to concentrate radioactive iodine.

In cancer of the thyroid, a measurable pick-up of iodine was found in 10 of 21 cases, but this pick-up was very low compared to that of normal thyroid tissue. In 5 of 12 patients having distant metastases which, at first observation, had very little to no measurable function, removal of the normal thyroid by surgery or radioactive iodine therapy was followed by a significant increase in the uptake of radioiodine by the metastases. In 3 cases it was then possible to treat these patients with radioactive iodine. The authors present two

theoretical explanations for this change: (1) that the normal thyroid, being present, stole the iodine that the tumor might otherwise have collected; (2) that, in the absence of normal thyroid, the tumor assumed the capacity to fulfill the organism's need for thyroid hormone.

Nine photomicrographs; 5 graphs; 9 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Foundation

Distribution of Tracer Doses of Methionine Tagged with Radiosulfur in Normal and Neoplastic Tissue. Arnold J. Kremen, Samuel W. Hunter, George E. Moore, and Claude R. Hitchcock. Cancer Research **9:** 174–176, March 1949.

A study of the distribution of tracer doses of methionine, tagged with radiosulfur in normal and neoplastic tissue, indicated a high initial concentration of radiomethionine in liver, tumor, kidney, and intestinal wall.

Five graphs.

Studies with Colloids Containing Radioisotopes of Yttrium, Zirconium, Columbium, and Lanthanum. I. The Chemical Principles and Methods Involved in Preparation of Colloids of Yttrium, Zirconium, Columbium, and Lanthanum. John W. Gofman. J. Lab. & Clin. Med. **34:** 297–304, March 1949. **II. The Controlled Selective Localization of Radioisotopes of Yttrium, Zirconium, and Columbium in the Bone Marrow, Liver, and Spleen.** Ernest L. Dobson, John W. Gofman, Hardin B. Jones, Lola S. Kelly, and Leonard A. Walker. Ibid., pp. 305–312.

Colloids of zirconium, columbium, yttrium, and lanthanum were chosen for study of selective localization of radioisotopes in the bone marrow, liver, and spleen because of the availability of isotopes of a wide range of nuclear properties and because of the comparative ease with which controlled variations in chemical structure and particle size of colloids containing these elements may be made.

In the first paper, methods for preparing zirconium and yttrium colloids of various chemical types and ranges of particle size are described. Three tables.

The second study is concerned with the localization of colloids of yttrium, columbium, and zirconium primarily in the bone marrow or primarily in the spleen and liver with an analysis of some of the factors which may be responsible for differences in localization. Colloids of zirconium of relatively large particle size show rapid disappearance from the blood stream and are deposited primarily in the liver and spleen. Colloids of smaller particle size, both of zirconium and yttrium, disappear much more slowly from the blood stream and are deposited primarily in the bone marrow and spleen, secondarily in the liver—the liver-specific activity being approximately one-third that of marrow. Both types of colloids, once deposited in these organs, show no significant change in distribution pattern, at least over a period of two to four weeks, and only slow excretion from the body. Two charts and 5 tables accompany this paper.

Distribution of Radioactivity in Tumor-bearing Mice after Injection of Radioactive Iodinated Trypan Blue. Charles D. Stevens, Alice Lee, Paul H. Stewart, Patricia M. Quinlin, and Paul R. Gilson. Cancer Research **9:** 139–143, March 1949.

The distribution of radioactivity in the tissues of 24 Swiss A mice, each bearing two subcutaneous implants of a mammary spindle-cell carcinoma, and of 5 control mice, was measured after intravenous injection of a radioactive dye mixture prepared by iodination of trypan blue in the presence of radioactive iodide. The tumor tissue showed several times as high a concentration of radioactivity as did the skeletal muscle or skin, but less than the liver, spleen, or kidneys.

The tissue distribution of radioactivity was similar to that found by others using radio-brominated dyes (Moore, et al.: J. Clin. Investigation **22:** 161, 1943). The distribution in mice injected with sodium radio-iodide^{131}, however, was quite different (unpublished material), indicating noticeably dissimilar behavior of radioactive iodine administered as sodium radioactive iodide^{131} and that administered as radioiodinated trypan blue.

One chart; 4 tables.

EFFECTS OF IRRADIATION

Factitial (Irradiation) Proctitis. A Clinicopathologic Study of 200 Cases. Marion S. Craig, Jr., and Louis A. Buie. Surgery **25:** 472–487, March 1949.

Two hundred cases of so-called factitial (irradiation) proctitis are analyzed. All the patients were women; 186 (93 per cent) had received irradiation for a malignant lesion in an extra-rectal pelvic organ. The remainder had been treated for a benign pelvic process. The lesions followed both roentgen and radium therapy; in some they appeared as early as a week after irradiation; in one they were postponed for nearly seven years. The symptoms, in order of occurrence, were: rectal bleeding, diarrhea, rectal pain, tenesmus, constipation, and abdominal cramping. In some instances there was a complicating factitial cystitis with urinary symptoms.

In more than half the patients (106) the lesion consisted in a simple proctitis or sigmoiditis without ulceration or stricture; in the remaining cases ulceration, stricture, and rectovaginal fistula were present, alone or in combination. The most common site of involvement was the anterior wall of the rectum in its middle third, but the location varied. The lowest third of the rectum was the only area not involved. In 19 of the 200 cases, the patient was referred with a diagnosis of rectal carcinoma.

Roentgen examination of the colon by administration of a barium enema was performed in 37 cases. In 10, a constriction with or without mucosal alteration was observed in the sigmoid beyond the reach of the sigmoidoscope. In 3 patients the constriction observed roentgenologically was identical with that visualized on proctosigmoidoscopic examination, and in each instance the roentgenologist was able to distinguish the lesion from carcinoma. Treatment consists of low-residue diet and various soothing instillations after bowel movements. Suppositories may be needed in the acute stage. No type of cautery should ever be used. Colostomy or plastic operation is sometimes necessary if a stricture causes obstruction.

Histologic characteristics suggestive of an irradiation

effect are: (1) thickening and hyalinization of the connective tissue, (2) abnormal fibroblasts, (3) telangiectasis, (4) intimal hypertrophy of the blood vessels, (5) degeneration and edema of the muscle tissue, with little or no sign of regeneration.

One roentgenogram; 5 photomicrographs; 3 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Blood Changes in Luminizers Using Radioactive Material. Ethel Browning. Brit. M. J. **1:** 428–431, March 12, 1949.

With the expansion of the British luminizing industry incident to the war, special effort was made to protect the workers from exposure to external irradiation by alpha particles and beta and gamma rays, and from inhalation and ingestion of radioactive substances. The present paper reports the results of blood examinations carried out on luminizers between 1940 and 1945 and follow-up surveys made from 1945 to 1949.

Deviations from the normal blood picture were characterized by a relative lymphocytosis with a moderately high total white cell count. Some abnormal cells including Türk cells, premyelocytes, and large mononuclears of immature type occurred in about 9 per cent of the workers each year. Anemia, even of very slight degree, was relatively infrequent.

Three hundred and sixty-six luminizers employed during the war have been followed up to date, having had no exposure for one to five years. Abnormal cells were found in only one girl, who suffered from an endocrine dysfunction. Relative lymphocytosis is present in only a few cases and is of slight degree. White cell counts are generally lower than during employment. Red cell counts and hemoglobin values show a fall.

The extent of exposure during employment was considered to be extremely small, and evidently most of this was due to inhalation of dust from small dried splashes of paint on the benches and floors.

In the early stages of overexposure to radium the one consistent sign is an absolute and progressive leukopenia. This sign was conspicuously absent in these workers between 1940 and 1947. On the contrary, the deviations in their blood picture suggest a hyperstimulative effect. This appears to be produced by a mode of action entirely different from the depressive effect on the bone marrow of external gamma radiation.

Five illustrations.

ALTON S. HANSEN, M.D.
Peoria, Ill.

Treatment of Radiation Sickness with Adrenal Cortical Hormone (Desoxycorticosterone Acetate). A Preliminary Report on Fifty Cases. Friedrich Ellinger, Bernard Roswit, and Samuel M. Glasser. Am. J. Roentgenol. **61:** 387–396, March 1949.

The authors advocate the use of desoxycorticosterone acetate in the therapy of radiation sickness. The rationale of this therapy is based on their belief that the symptoms of irradiation sickness are due to the liberation of histamine or histamine-like products. Desoxycorticosterone acetate is known to counteract certain toxic reactions of histamine.

Radiation was given to 50 patients for benign and malignant conditions. All of these patients had symptoms of irradiation sickness, including nausea and/or vomiting, and were treated with desoxycorticosterone acetate. Of the 50 patients, 37 were completely relieved of nausea and/or vomiting. Correlation of desoxycorticosterone acetate results with the body section treated showed that the best results were obtained where the treatment field included the liver. Of 27 cases irradiated over the abdomen and trunk, 23 showed complete relief from nausea and/or vomiting with the use of adrenal cortical hormone. As a possible explanation, one of the authors had shown previously that desoxycorticosterone acetate protected the liver of the mouse against irradiation-induced fatty changes.

Treatment with desoxycorticosterone consisted in intramuscular injection of 5 mg. every eight hours. The drug was given until relief of symptoms was obtained, but not for more than five days, in order to avoid over-dosage. In instances of failure to respond to therapy while the irradiation was being continued, additional courses were given at two- to five-day intervals.

Six tables.

NORMAN GLAZER, M.D.
Cleveland City Hospital

Surgical Treatment of X-Ray Burns. Thomas W. Stevenson. Rocky Mountain M. J. **46:** 198–200, March 1949.

There are two types of deep ulceration following irradiation. In the acute type the initial erythema progresses rapidly, vesicles appear, and later the skin becomes necrotic. The sloughing off of necrotic tissue is greatly retarded and may not occur for several months. Granulation tissue fails to appear and no sign of marginal epithelization is seen. The retarded slough and lack of granulation tissue and epithelization distinguish this lesion from any other form of traumatic wound. Pain is usually a striking feature, the slightest drying of the surface or pressure of a dressing causing extreme discomfort.

In the chronic form, ulceration may take place in an area which had remained healed for several years. This usually results from progressive fibrosis and consequent reduction in local blood supply, which eventually leads to ischemic necrosis. Intense pain is also a feature of this type of ulceration.

Complete excision of the involved area with skin grafting is the treatment of choice.

In the author's experience the source of the largest group of superficial injuries was the treatment of hypertrichosis, fracture reduction, and various dermatologic conditions.

DONALD S. CHILDS, JR., M.D.
The Mayo Foundation

Clinical Manifestations of Acute Radiation Illness in Goats; Comments on Therapy. Eugene P. Cronkite. U.S. Nav. M. Bull. **49:** 199–215, March–April 1949.

This paper, originally issued by the Naval Medical Research Institute, was abstracted in Radiology **52:** 308, February 1949.